Executive Summary

The Unemployment Compensation Modernization System (UCMS) program was envisioned as the means to re-engineer business processes for delivery of unemployment insurance (UI) benefits to citizens, replace critical legacy information systems with new technology, and provide increased functionality to state employees, employers, and citizens. UCMS was planned to first implement a new information system technology infrastructure and then deliver new business functionality in three software applications releases: R-1 (case management and wage records), R-2 (employer tax), and R-3 (claims processing, payments, and appeals).

By industry standards, the UCMS is considered a large-scale project due to its complexity, size in software lines of custom developed code, and its cost. As of July 2013, the UCMS program will be 42 months behind the schedule set at contract award and based on the original contract price of $106.9 M, the Commonwealth has now dedicated funds approaching $170 M to the project. The Commonwealth issued no-cost contract extensions that expire on September 30, 2013 to allow time to further assess the program's status. The current DLI senior executive team has taken a hands-on and aggressive approach, beginning in 2011, in order to control and manage the UCMS project. In light of the situation, the current Secretary of DLI directed an independent assessment of the UCMS program to inform judgments about its future. This report presents the key findings and recommendations from this assessment and responds to DLI's key questions:

- Should DLI continue with UCMS?
- Can DLI operate, sustain, and evolve UCMS?
- What changes are necessary to solve the critical path issues?
- Are contractor and DLI resources sufficient to address these issues?

Context

The most critical element of the UCMS is Release 3 (R-3). R-3 must deliver the operational capability to process unemployment claims, calculate payments, and enable timely payments to eligible citizens of the Commonwealth who are out of work. R-3 must operationally perform these critical functions the "first time and every time" when deployed to be the sole information system supporting administration of the Commonwealth's Unemployment Insurance (UI) program. UCMS is therefore a mission critical system and R-3 must perform to a high degree of reliability, consistency, and accuracy for beneficiaries to receive timely payments and to enable DLI to have high confidence it can terminate operations of the legacy unemployment compensation information system.

The crux of the issue is that the UCMS R-3 software application has yet to demonstrate the mission critical capability to reliably, consistently, and accurately process unemployment claims, calculate payments, and enable payment to eligible citizens who are out of work. More importantly, there is no high confidence estimate for when the UCMS, as an integrated operational system, will demonstrate the level of performance necessary for DLI to justify a decision to approve its deployment as the sole Commonwealth UI enterprise information system.

Key Themes from the Assessment Findings

The assessment's key findings center around three themes that are summarized below: (1) quality of the system, (2) UCMS acquisition strategy and Contractor plans and assumptions, and (3) governance and program management. The specific assessment findings addressed in the assessment report appear in Figure 1 at the end of the Executive Summary. Two critical threads run through these three themes—risk and rebaselining (or restructuring).

In the context of system acquisition, risk refers to the probability of an event occurring and the consequences of this event impacting program (UCMS) performance goals and objectives within defined cost, schedule and performance constraints. Risk management is a continuous process accomplished throughout the system life cycle for identifying and making an assessment of the unknowns; developing mitigation options; selecting, planning, and implementing appropriate risk mitigations; and tracking the implementation to ensure successful risk reduction. Effective risk management is driven by leadership and management making risk an explicit consideration in organizational and program governance.[1]

The term rebaseline refers to restructuring the scope, content, and schedule of a program. Rebaselining is driven by decisions on the part of the customer (DLI) to first revise the goals, objectives, and outcome measures of the acquisition program. Subsequently the scope, content, and schedule of the program are realigned based on those decisions to achieve a higher confidence, lower risk approach.[2]

- **Quality of the system.** The term quality refers to the degree to which a system or software exhibits some combination of attributes or characteristics that have been explicitly defined and have value to the customer or user (DLI).[3] The UCMS solicitation did not specify a required set of attributes or particular quantitative system performance requirements. Rather, the solicitation requested bidders propose such criteria. The Contractor's proposed technical infrastructure (production and test environments) is in operation and the Contractor and DLI successfully implemented a planned upgrade of the UCMS infrastructure in February 2013. However, as DLI's OIT staff has assumed more responsibility for the UCMS test environments there are some issues that remain unresolved in DLI's view regarding why some processes work in the production environment, but not in the test environment. While the UCMS infrastructure is functioning, its performance limits are not known since the Contractor has not performed a UCMS stress test which is essential to provide critical planning information to DLI on the performance limits of the system. The UCMS infrastructure does have the inherent capabilities to be evolved and its operational performance can be tuned by DLI staff to address changing demands, data needs, interface impacts, and other factors.

  The Contractor's software development plan was based on using industry and company standards and practices. However, the discipline to execute these standards and practices eroded beginning early on in the program. In this environment, DLI accepted R-2 prematurely into production in March 2011 with known defects impacting performance. Material deficiencies continue to be discovered in R-2. These deficiencies include software defects, unresolved data conversion issues, and problems with batch processing operations.

DLI and the Contractor are at a stalemate over R-3 which is based on a significantly larger number and more complex set of business rules than R-2. This stalemate occurred because the DLI staff approved the Contractor's representation of business system requirements (in the form of use cases) without fully understanding what they were approving coupled with a lack of rigor and discipline in the Contractor's UCMS development and testing program. The result has been (1) a higher number of software defects than industry norms, (2) high code complexity which degrades testability, and (3) late discovery of missing business requirements.

The UCMS R-3 software has a significantly higher defect density than industry benchmarks. The vast majority of these (86 percent) are Severity Level 2 (serious failure) defects, indicating the persistence of systemic problems over a sustained period of time. Fully 50 percent of these defects were discovered during User Acceptance Test; this late discovery of defects is symptomatic of an ineffective System Test. Of even greater significance, systemic deficiencies in the testing program mean that there is no way to know how many of the total defects that reside in the code have actually been discovered. Simply by testing less effectively, fewer defects will be discovered.

Cyclomatic complexity (CC), another widely used industry indicator of software quality, represents the number of independent paths through the program source code. The CC number for individual modules or units can be calculated using one of several commercial tools. Best industry practice seeks to limit the complexity of individual code units to 10 or less because software modules having a CC greater than 10 have a higher risk of defects and a higher risk of "bad fixes" in which attempts to correct a defect result in new defects being inadvertently created. Typically, CC values exceeding 20 should be considered as alarming. While the percent of UCMS software modules with a CC greater than 10 is small, about 1,600 modules have a CC value greater than 20 which indicates a moderate to high risk. Of those with a CC greater than 20, almost 100 have a value of 50 or greater which means that they are not testable in a practical sense. The discovery of defects in User Acceptance Test may be, at least in part, the result of the high CC factor in these modules.

- **UCMS acquisition strategy; Contractor plan and assumptions.** The UCMS solicitation was sufficient to enable bidder response, but it exhibited four major weaknesses: (1) unprioritized and often ambiguous requirements, (2) lack of detailed and objective source selection criteria, (3) the lack of specification of detailed DLI UCMS operational system attributes, performance measures, associated metrics, and a risk management framework, and (4) the absence of an explicit risk assessment of bidder plans, schedules, and assumptions. The Contractor's proposal was consistent in scope and content with the expectations for a proposal from a major technology firm. The Contractor's proposed System Development Life Cycle (SDLC) approach was based on the Rational Unified Process (RUP) and other requirements as specified in the Commonwealth's solicitation. Using this approach, the Contractor planned a highly concurrent schedule for R-1, R-2, and R-3 SDLC activities starting at the same time with all three releases delivering within a 20-month period. The Contractor's approach entailed the planning, control, and timely integration of a large number of complex, concurrent, and often interdependent activities that are labor and management intensive. The initial criti-

cal path task in this approach was the effectiveness of the process for capturing user business requirements to the satisfaction of DLI. DLI's lack of confidence in the effectiveness of this process has been a major contributor to the current DLI – Contractor impasse regarding R-3.

Based on interviews with DLI and Contractor staff, the SEI Assessment Team identified three key assumptions in the Contractor's project plan that served to create further risks with major schedule and cost impacts: (1) there would be no UC legislative or rule changes even though this was contrary to previous legacy system history, (2) UC claim demands would remain constant, and (3) there was no need to analyze and understand the UC legacy system code, business logic, and data base to facilitate develop of UCMS. DLI did not conduct a formal risk assessment as part of its source selection process to explicitly address issues, concerns, and to identify such assumptions to inform negotiations. As a result, DLI and the Contractor had different expectations and understandings about the planning and execution of the program at contract award.

- **Ineffective governance and program management**. DLI's and the Contractor's plans were not well implemented. The Contractor track record of ineffective project management led to weaknesses in process and practice discipline. Concerns about the feasibility of Contractor project plans and the accuracy of its dashboard status reports to DLI were noted as early as 2008 by DLI's Independent Verification and Validation (IV&V) contractor. Another concern has been instability in the contractor's workforce creating discontinuity in the transfer of knowledge within the Contractor team to inform planning. For example, after completion of the Detailed Design Documents in August 2008, the Contractor rolled a large number of business analysts, who had become the contractor's "project memory" of UC business requirements, off the project. This decision created a significant knowledge gap as the program entered the critical application design and development phases. The consequences of this gap were amplified because the Contractor did not include application code developers and testers in the Joint Application Development (JAD) process which is an industry best practice. As a result, serious knowledge discontinuities existed in the Contractor's workforce about UC business processes to inform development and testing.

  Further discontinuities were created when the contractor's project manager and executive both left the project in early 2009 during a critical time. The size and churn within the Contractor's workforce has also contributed to program discontinuity. Since the start of the project, 638 different contractor staff members have worked on the project with the majority of the workforce having less than one year on the project and 75 percent having less than two years. [4] The churn of the workforce has likely impacted efficient project planning and execution.

  From the start, DLI was not able to provide adequate resources to staff its planned management and governance approach. Further, DLI made no formal delegation of roles, responsibilities, and authority for management of the program. DLI's approach to managing the UCMS program from contract award to early 2011, led to a situation in which no one in DLI was accountable and responsible for the administration of the program. As a result, there was no ef-

fective oversight or timely action to make definitive decisions to mitigate the systemic risks that were continually highlighted by the IV&V contractor.

The cumulative impact of the discontinuities in the Contractor's approach along with the dynamics of the workforce churn likely contributed to the Contractor's schedule and project management system not presenting an accurate picture of the state of the program. The Contractor's initiatives in 2012 to instill more rigor and discipline were on the right track, but came too late to change program outcomes. The discontinuities in the program together with weaknesses in DLI governance and program management further served to create differing views about the status of the program on the part of DLI and the contractor which continue to this date.

DLI's Questions

- **Should DLI continue with UCMS?** DLI should continue with R-1/R-2 and concentrate, as a priority, on maturing the Tax System functionality to resolve defects, data conversion, and system performance issues. DLI should not continue with the R-3 program. The characteristics of R-3 do not provide a high level of confidence that its intended goal will be achieved considering current fiscal, schedule, and risk considerations. More importantly, (1) there is no reasonable basis for a high confidence estimate for when R-3 will successfully complete DLI user acceptance testing and then (2) demonstrate the operational maturity to be the high confidence core mission critical information system for enterprise-wide UC claims processing and payment. Further, premature operational deployment of R-3 may create an inherently high level of potential for some types of failures with the consequence of degrading delivery of UC beneficiary services, specifically payments to citizens who are unemployed. R-3 can be rebaselined to a lower risk, higher confidence strategy based on successful accomplishment of key events. Alternatively, DLI could pursue other approaches to acquire UC functionality equivalent to that provided by the legacy system that would operate on the UCMS infrastructure and enable DLI to confidently terminate UC legacy system operations.
- **Can DLI operate, sustain, and evolve UCMS?** DLI does not have the capability for development and sustainment of UCMS' software applications. DLI does have the capability to assume greater responsibility for management of the UCMS production and test environments, with certain caveats as described in the paragraph below. The UCMS infrastructure has inherent characteristics that allow it to be evolved over time reflecting the characteristics of off-the-shelf technology (hardware and commercial off-the-shelf software) selected by the Contractor at the time of contract award as well the constraints specified in the solicitation. The characteristics of this infrastructure will create challenges for DLI. These challenges are related to a lack of expertise and the staffing capacity needed to sustain the custom application code base, tune the database and infrastructure, and transition some of the UCMS infrastructure from niche COTS products to less expensive, open source alternatives as determined to be appropriate by DLI. A major consideration is the need for DLI to begin planning now to

replace the UCMS portal technology due to decisions by the State Office of Administration regarding changes to the Commonwealth's portal capability, which is the gateway to UCMS.

- **Are contractor and DLI resources sufficient to address these issues?** DLI's IT resources are not sufficient in three critical areas: (1) skills and staffing capacity for sustainment of the UCMS software applications, (2) skills and capacity for acquisition/project management, systems engineering, and integration of complex programs, and (3) the range and depth of the specialized skills and capacity related to the management and operations of more modern technology environments like UCMS. The current DLI CIO has had success in assuming greater responsibility for management of the UCMS processing environment due in large part to extraordinary efforts of the OIT staff in the face of major challenges. However, the level of intensity that enabled this success will be difficult to sustain without greater range and depth of specialized skills and capacity. The Contractor has an expansive resource base of relevant knowledge, tools, practices, and experience to draw upon. However, these inherent capabilities do not necessarily transfer directly to the effective execution of a specific development program (UCMS). There are concerns about the Contractor's ability to effectively staff and manage a qualified on-site workforce at DLI based on three factors: (1) discontinuities in the contractor's workforce as detailed in this report, (2) DLI's on-going experience with the Contractor's challenges in providing on-site staffing of the R-2 sustainment contract with requisite specialized technical staff including business analysts, and (3) the Contractor's ineffective project management that led to weaknesses in process and practice discipline. The degree to which these concerns can be successfully mitigated near term is uncertain.

Recommendations

These recommendations identify strategic courses of action for consideration by DLI senior executives and they are grouped into two categories. The first set of recommendations identify seven critical courses of action that are essential to first enhancing DLI's capacities for managing complex technology programs and sustaining the current core mission. The second group of recommendations deals with the next steps regarding options related to the UCMS program.

- **Initial Imperatives**
  - Take ownership of UCMS and become aggressive in oversight and management of the contract and program. Beginning in 2011, actions by DLI executive leadership have changed the dynamics for day-to-day management of UCMS and for creating a strategic approach to address the systemic issues that are critical for UCMS life cycle success. This focus must continue. Create a rigorous and integrated governance structure to include re-establishing the IV&V function with regular engagement of DLI senior executives to ensure that IV&V findings are addressed.
  - Establish explicit criteria for the meaning of success and "go no-go" operational deployment decisions that are enabled by a performance measurement system. The absence of such explicit criteria, based on system attributes of value to the user, created different expectations between the Contractor and DLI about the level of operational system capability to be delivered and what is acceptable. The criteria should be set based on con-

siderations of UCMS not just as R-1, R-2, and R-3; but rather as an integrated operational enterprise system.

- Adopt and use a formal DLI risk management process to drive DLI senior executives and project managers toward timely risk mitigation decision actions.
- Appoint a skilled and experienced program manager (and deputy) who is empowered with authority to direct and control the program and contract; create and staff a dedicated program management organization with all necessary functions and performance measurement capabilities.
- Realign the position of DLI CIO to report directly to the Secretary as a Line-of-Business creating a peer-to-peer, partnership relationship across the senior executive staff.
- Execute and resource a strategy to operationally sustain the UC legacy system as a UC "insurance" policy until a high confidence operational information system capability for unemployment insurance claims processing and payment has been operational demonstrated to meet expectations.

- **Next Steps for UCMS**
  - Stop the current R-3 effort. While complex, large-scale projects generally have degrees of risk and pressure to meet schedule, the current R-3 effort is proceeding with no high confidence of immediate game changing outcomes.
  - Make maturation and achieving operational stability of R-1/R-2 the highest priority.
  - Begin technical and program planning to identify and evaluate affordable UCMS portal alternatives and interim strategies with the Commonwealth's Office of Administration
  - Rebaseline (restructure) the R-3 effort or seek an alternate pathway to acquire UC functionality equivalent to the legacy system as a first step. The scope of the R-3 rebaselining approach is described in Section 3 of this report. If DLI seeks an alternative pathway to R-3, this approach should be targeted to creating an essential operational UC functional capability that minimally provides the functionality of the legacy system to enable transitioning the UC business from the legacy system. This alternative minimum capability should be designed to enable incremental enhancements to achieve the DLI UC business vision and goals based on affordability and risk considerations.
  - In winding down the R-3 effort, DLI should: (1) require the Contractor conduct and document a stress test for R-1/R-2; (2) conduct a complete review of contract requirements for deliverables, their status, and quality with emphasis on tools and technical data including source code, and (3) insure the Contractor fully documents all code and tests to insure a complete record for use in any future efforts.

Conclusion

The problems evidenced in the UCMS program are not unique, but are too systemic in the acquisition of complex information technology systems. These problems are examples of the challenges organizations often experience in attempting to plan and execute complex software-intensive

technology acquisitions that exceed the organization's skills and capacities for program management and governance of complex, large scale technology projects.

The findings from this assessment should not detract from recognition of the positive factors which can contribute to achieving the goals of the UCMS program. These factors include:

- The strong leadership of current DLI senior executives starting in 2011 to make decisive and timely decisions about the future of the program.
- The high level of commitment and passion of the DLI staff to the organization's mission and to achieving UCMS success.
- The UC legacy information system is an enterprise asset with proven performance and reliability that has mitigated UCMS program risk.
- UCMS represents a significant investment in delivering knowledge, tools, data, and information to enhance DLI's infrastructure processes and practices. The UCMS infrastructure was successfully installed, upgraded, and is in operation and the DLI OIT staff has demonstrated the ability to assume greater responsibility for its operation.

The UCMS success that has been achieved is due to the heroic efforts of individuals within DLI. These individuals are passionate about the DLI mission and persevered in the face of monumental challenges that they did not know and understand at the time the project started. However, such an intense level of effort cannot be sustained and suffice for creating the institutional capacities needed for the task at hand.

The current state of the program is the result of the accumulation of risks and issues that were continually identified over a critical four year period (January 2007-June 2011) of the program. However, these indicators were not acted upon decisively by DLI senior executives at the time to mitigate the systemic risks in the program. These risks continued to roll forward with increasing impact on the program schedule. The Contractor has taken several initiatives to address program performance issues, but these actions have not resulted in game changing outcomes.

The current Secretary of DLI and the current Deputy Secretary of UC have recognized these issues and have taken the initiative to assume control over the UCMS program and consider how best to proceed. The task is formidable since in these situations there are no quick "silver bullet" solutions to the challenges. However, options such as rebaselining R-3 or seeking alternative acquisition pathways are feasible in working toward a lower risk, higher confidence approach to deal with the UCMS challenges. This lower risk, high confidence approach should be based on first delivering a demonstrated minimum essential UC functionality equal to the UC functionality provided by the legacy system. This approach will allow DLI to retire the UC legacy system and then relocate resources to begin incremental enhancement to the UCMS UC functionality as determined to be of value and affordable.

Key Themes and Findings

- **Quality of the System**
  - There is no high confidence estimate for when R-3 (UC Claims and Payments System) will demonstrate the performance necessary to justify a decision to deploy R-3 as the sole UC enterprise system.
  - The lack of integrity in UCMS requirements and testing are systemic risk factors continuing to contribute to schedule delays and lack of user confidence.
  - Code quality particularly for R-3 is a major risk factor; there is no way to know how many of the total defects that reside in the code have actually been discovered given the lack of test discipline.
  - UCMS' architecture performs as designed and can be evolved, but its design is not driven to meet specific user attribute requirements and its performance limits are not known.
  - The high concurrency of the Contractor's approach coupled with schedule pressure and DLI capability and capacity limitations create risk for effective transition, sustainment, and the ability to manage the evolution of UCMS.
  - The UCMS program can be rebaselined to achieve a higher confidence, lower risk approach to address critical issues and achieve success based on affordability and commitment considerations.
- **UCMS Acquisition Strategy; Contractor Planning and Assumptions**
  - The UCMS acquisition approach created a nexus of factors generating major and continuing risk to the program and mission success.
  - DLI's UCMS solicitation was extensive and detailed; however, it exhibited key weaknesses that disadvantaged DLI in the source selection for a large scale development project and the subsequent management of the contract and program.
  - The Contractor's proposal was extensive and reflected what would be expected from a major system integration company in terms of scope and content. The Contractor's System Development Life cycle approach was based on the Rational Unified Process, but its implementation coupled with unrealistic planning assumptions created inherent risks at program initiation.
- **Governance and Program Management**
  - Overall, project governance and project management were insufficient for the complexity of the UCMS program to achieve project and mission goals.
  - The Contractor's "plan on paper" for program management in the proposal was comprehensive reflecting what would be expected from a major systems integration firm. However, status information presented on the performance of the program did not logically flow from program measurement data to provide a clear view of the actual state of the program over time.
  - DLI did not implement an effective governance and program management approach. As a result, DLI was at a significant disadvantage in having the program management and governance capacities to effectively administer the contract, provide oversight, and engagement with Contractor senior managers and executives.

Figure 1: Key Assessment Themes and Findings