AUDITOR GENERAL'S REPORT

Information Technology Infrastructure and Asset Management Review:

Phase 2: Establishing Processes for Improved Due Diligence, Monitoring and Reporting for Effective IT Projects and Asset Management

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EXECUTIVE SUMMARY

Information Technology infrastructure and asset management audit initiated in 2017

The Auditor General initiated the audit of the City's Information Technology (IT) infrastructure and asset management in 2017. The results of Phase 1 of this review were presented to the Audit Committee on February 7, 2018. This current report provides results of Phase 2 of the audit.

The Phase 1 report is available at:

https://www.toronto.ca/legdocs/mmis/2018/au/bgrd/backgroundfile-112385.pdf

Phase 2 report identifies issues related to various IT projects and initiatives

In this Phase 2 report, we have identified the following issues related to various IT projects and initiatives:

- The Information Technology Asset Management (ITAM) System is not viewed as reliable due to incomplete and inaccurate information

- There appears to be insufficient due diligence in acquiring IT assets and solutions as evidenced by hardware and software that was purchased either in excess of needs or was not used for the intended purpose

- Significant delays in IT project implementation

- Need for better monitoring and management of usage of software licences on an ongoing basis

- A need to ensure new more cost effective IT service delivery options are considered and implemented where appropriate.

Additional information regarding these findings follows.

In 2006, the City spent $1.5 million on an ITAM System

ITAM System is Still Deficient

In 2006, the City spent $1.5 million to acquire an ITAM System for managing the City's inventory of IT assets. In 2010, a decision was made to replace the system, which was not able to meet the City's evolving requirements.

$5.5 million spent on new ITAM System since 2010 and the system is not yet reflecting complete picture

The new ITAM System has been under implementation since 2010, and approximately $5.5 million has been spent on the acquisition, maintenance and staff resources as of December 2017. This system is still not reflecting a complete and accurate picture of IT assets at the City.

33% of IT asset purchase invoices we tested were not reflected in the ITAM System

We selected 21 IT asset purchase orders and for seven of them, the related assets had not been recorded in ITAM System. For another three purchase orders, the assets were recorded but significantly later than the purchase date, in one case, a delay of up-to two years. These purchase orders included 110 various IT assets for a total purchase value of $402,000.

The City is now 12 years down the road from the initial purchase of an ITAM System and eight years on from the time the first ITAM System was abandoned and a second system was acquired. A concerted effort needs to be made to ensure the ITAM System is updated and stays accurate going forward.

Acquisition of Excess or Inadequate IT Assets

3,500 desktops were purchased at a cost of $1.9 million in December 2015

A total of 3,500 desktops were purchased at a cost of $1.9 million in December 2015 in anticipation of changes to Microsoft software that would make new computers incompatible with several City systems.

1,440 out of 3,500 desktops were still in stock as of September 2017

As of September 1, 2017, 1,440 out of 3,500 desktops valued at $782,000 were still in stock at the vendor's warehouse. Many of these computers have since been deployed, but these assets have a limited technological life span and much of it has been used up sitting in a vendor's warehouse, where the City paid $75,000 for storage.

A Second Example is the City's Acquisition of a Procurement Solution that was Never Implemented

The City incurred $4.7 million for a SAP Procurement solution that was never implemented

From 2007 to 2016, the City incurred an aggregated expenditure of $4.7 million for SAP Procurement solution licences and maintenance costs. In 2014, a third-party assessment of the package identified the detailed work that needed to be done for the system to meet the City's needs. City staff estimated that implementing the system to meet the City's needs would cost an additional $27 to $30 million. This price tag led staff to seek another solution.

The I&T Division was able to get a credit of $4.7 million paid for the SAP Procurement solution over a five year period

SAP's Ariba cloud solution was identified as being a cost-effective solution. The purchase documentation for this new solution indicates that the City received a credit of $4.7 million over a period of five years for the SAP Procurement solution which was never implemented. The nature of software pricing makes it difficult for us to verify that the credit has been received.

It appears the City will pay $2.5 million in subscription costs, but may not receive the intended benefits for the period of delay

The SAP Ariba cloud solution consisting of various modules was expected to be implemented from Q3 2017 to Q2 2018. Currently, the project's implementation is delayed by over a year. The City will pay $2.5 million in subscription costs during the period of delay, but it will not receive the intended benefits. It appears that the City will be required to pay these subscription costs even if there are further delays.

Other examples of apparent acquisitions of excess licences have also been identified

We have identified several other examples of apparent acquisitions of excess licences. Table 2 in the body of the report cites unproductive costs in the $1.1 million range for licences purchased either in excess of needs or too early based on the time it would take to implement related systems.

Adoption of New Service Delivery Solutions

There has been a steady shift in the industry from entities owning and maintaining dedicated servers for specific applications to server sharing (virtual servers) and use of cloud services (servers and related software owned and maintained by a third-party provider).

The City has made progress on moving to virtual servers and cloud solutions

While this is a good start, more can be done

The City has made progress on moving to virtual servers and cloud solutions. While this is a good start, more can be done. Moving in this direction is within the realm of expertise of the I&T Division. In our Phase 1 report, we recommended strengthening the role of the Chief Information Officer (CIO) to have authority over other City divisions, agencies and corporations and establishing a Strategic Technology Roadmap to identify opportunities for improving the City's IT infrastructure.

We understand our recommendations are being implemented, which should accelerate the move to alternate service delivery platforms allowing the City to reduce costs and improve services.

Finally, although agencies and corporations were not included within the scope of our audit, this report contains a number of findings and recommendations that are relevant to them. It would be beneficial to have this report forwarded to the agencies and corporations for their consideration and any actions deemed necessary.

Conclusion

This report highlights a number of key issues that need to be addressed by the I&T Division and the City as a whole

This report identifies a number of areas for improvement that can enhance the City operations through the provision of accurate IT assets data, improved monitoring and reporting on IT project implementation and software utilization, and a shift to new cost effective alternate service delivery options. The report makes eight recommendations to address the issues identified.

We express our appreciation for the co-operation and assistance we received from the management and staff of the I&T Division and other City divisions.

BACKGROUND

The Information & Technology Division's role is to provide leadership

The I&T Division's role is to provide city-wide leadership in modernizing City services through the development and management of the City's Information Technology (IT) systems.

The I&T Division's 2018 Operating budget is $130.4 million, and its 10 year Capital Plan (2018-2027) is $421 million.

City has a large and complex IT environment

The City's IT Environment is comprised of a complex infrastructure of applications, networks, and computers spread over 700 locations, servicing more than 50 City divisions, as well as the 2.9 million citizens who call Toronto home.

The on-premise IT infrastructure includes 2,700 servers that host over 850 systems. Members of the public also use certain City applications, such as the community recreation registration system, the permit system, the 311 system, and various payment systems.

A glossary of terminology is included in Exhibit 1 to facilitate the understanding of certain technical terms used in this report.

AUDIT RESULTS

This section contains findings from our audit followed by specific recommendations

This section of the report contains the findings from our audit followed by specific recommendations. The key themes discussed in the following sections are:

- Software and hardware assets purchased but not used for extended periods
- Exercising thorough due diligence in acquiring IT assets and solutions
- Strengthening the monitoring of the execution of IT projects and initiatives
- Establishing a reporting dashboard for management oversight and action.

The I&T Division and other City divisions have joint responsibility to conduct thorough due diligence on IT Projects and initiatives

It is the joint responsibility of the I&T Division and other City divisions sponsoring IT projects and initiatives to conduct thorough due diligence before deciding to purchase and implement a software solution. This must include a detailed analysis of business requirements, financial implications, an adoption plan and expected outcomes. Failing to adequately plan for a software acquisition and implementation can, and likely will, lead to a waste of City resources.

This report highlights instances

- where software licences were purchased but not used at all or not used for a long period of time

- computers were purchased in bulk but not deployed for a significant amount of time (over 20 months)

- the City's IT Asset Management (ITAM) System is not functioning as intended to aid management in recording, monitoring and controlling its IT assets

- where cost savings can be achieved through migration of physical servers to cloud services or virtual servers.

The issues reported are not new and have been reported several times in the past

We have reported on similar issues in the past. This must be corrected to ensure the City is efficiently acquiring and using its significant investment in IT assets.

Further, the information included in the ITAM System is unreliable. Appropriate systems and efforts need to be established to keep it up-to-date and relevant.

There needs to be a consolidated reporting dashboard to provide management with a snapshot of overall financial impacts, forgone benefits due to project delays and unused assets and licences.

A.   PROBLEMS RELATED TO IT ASSET MANAGEMENT

A.1.   IT Asset Management (ITAM) System is Not Effective Eight Years after Acquisition

The ITAM System is not being kept up-to-date

The ITAM System is not being kept up to date for changes in assets as they are acquired, moved within the City, enhanced, or disposed of. The ITAM is the foundation for the City to manage its inventory of IT assets. The City needs to have accurate information on the acquisition, deployment status and maintenance of its assets for optimum management. The ITAM System does not currently provide that information reliably.

The ITAM System purchased in 2006 was scrapped in 2010

In 2006, the City acquired an ITAM System for $1.5 million. This system was discontinued after four years because the system was not providing the expected results, such as the City's evolving needs to maintain inventory of its virtual machines.

$5.5 million has been spent as of December 2017 on the current ITAM System

In 2010, the City purchased another system to manage its IT assets. A total of $5.5 million has been spent on this system for licences, maintenance and supporting resources as of December 2017. However, the system still does not have a complete picture of City-wide IT assets.

Auditor General previously issued three audit reports related to IT asset management

The Auditor General's Office has consistently reported issues related to IT asset management and provided recommendations to address the issues.

2006 – Management of City Information Technology Assets

In 2006, we issued a report with a number of recommendations to improve controls over the acquisition, maintenance and disposal of IT assets. Implementation of an ITAM System was identified as a priority.

https://www.toronto.ca/legdocs/2006/agendas/committees/au/au060222/it003a.pdf

2011 – Governance and Management of City Computer Software Needs Improvement	In 2011, we issued another IT report noting that although progress had been made on tracking and management of hardware assets, the I&T Division had not been successful to any significant extent in improving its management of software assets. https://www.toronto.ca/legdocs/mmis/2011/au/bgrd/backgroundfile-35912.pdf
2015 Software Licences – Managing the Asset and Related Risks	In 2015, we issued a third IT report where we looked more closely at software acquisitions and control. We noted instances where better control was required over the acquisition of software, responsibility for monitoring licences needed to be assigned for about 25 per cent of the City's software titles, and staff were well behind in implementing the ITAM System acquired in 2010. https://www.toronto.ca/legdocs/mmis/2015/au/bgrd/backgroundfile-76330.pdf Although management has implemented many recommendations made in those reports, the core issue of fully populating the ITAM System with reliable asset information has not yet been resolved.

A.1.1.   Incomplete ITAM Information Impacts Management Oversight

For 7 out of a sample of 21 IT assets purchase orders, the assets were not recorded in the ITAM System	We selected a sample of 21 purchase orders relating to information technology assets purchased from 2015 to 2016 to determine whether the assets were recorded in the ITAM System. For seven out of the 21 purchase orders sampled, the purchased assets were not recorded in the ITAM System. These seven purchase orders included 42 various IT assets for a total purchase value of $67,500.
Delays of up to 2 years in entering purchased assets into the ITAM System	For three of the 21 sample purchase orders, the related asset information was entered into the ITAM System very late. In one case, the ITAM System was updated with a delay of up-to two years. The three purchase orders included 68 various IT assets for a total purchase value of $334,500.

Not all divisions have access to the ITAM System	In addition to the review of the sample purchase orders, we inquired with various divisions about their IT asset management practices. The Fire and Paramedic Services divisions mentioned that they manage their IT assets using separate spreadsheets. Both divisions stated that they do not have access to the City's ITAM System. We compared IT assets listed under both divisions' spreadsheets with the ITAM System and found that 33 IT assets valued at $102,000 were not recorded in the ITAM System.
Network Assets critical to City's day-to-day business are not up-to-date in the ITAM System	Network assets, such as firewalls, switches, and routers critical to City's day-to-day business are not up-to-date in the ITAM System to reflect the current status of these assets. The I&T Division advised us that a review is currently underway to assess the implementation of an automated solution (known as a discovery tool) to identify these network devices connected to the network. Identifying these assets is the first step in reconciling to the ITAM System to update it for all assets. The ITAM System is Not Up-to-date Due to Access Restrictions from the Segregated Networks
Restricted access to certain divisional segregated systems impairs the ability to update the ITAM System	In addition to the Corporate I&T network, the City has other segregated networks maintained by other City divisions. The IT assets in segregated networks are not updated in the ITAM System since other City divisions restrict access to the ITAM System discovery tool for certain operational reasons. A secure communication tool or an alternate process is needed to address restricted access to certain segregated networks. Note that this issue was also identified in our 2015 audit report but has not yet been resolved.

The ITAM System Reports Need to be Promoted and Shared

The ITAM System produces reports showing what is in the ITAM System versus what has been discovered by the ITAM System discovery tool. These reports are useful in facilitating timely reconciliations to ensure assets are accurately recorded in the ITAM System. Any discrepancy noted should be followed up with the respective divisions. The I&T Division should update the ITAM System on a timely basis to reflect the current status of IT assets at the City.

Duplicate records are maintained by certain divisions due to lack of confidence in the ITAM System records

Staff in several divisions advised us that they were not aware of the ITAM System discrepancy reports. In some cases, these divisions maintain a separate database or spreadsheet to track their IT assets. These duplicate records are maintained because divisional staff do not have confidence that the ITAM System is accurate, complete and up-to-date.

Recent Actions to Address ITAM Issues

Asset Management Task Force created to address ITAM concerns

The I&T Division advised us that IT asset management has become a top priority. The new Deputy CIO created an Asset Management Task Force in November 2017 to address the concerns raised in various Auditor General reports. The Auditor General will review the progress of the task force when following up on the implementation of the audit recommendations.

> **Recommendation:**
>
> 1.   **City Council request the Chief Information Officer to:**
>
>   a.   **Develop a process to ensure timely synchronization of IT asset purchases recorded in SAP with IT Asset Management (ITAM) System records**
>
>   b.   **Expedite reconciliation of network assets and update them in the ITAM System**
>
>   c.   **Develop secure communication mechanisms (or an alternate process) to allow for the update of segregated networks' IT assets in the ITAM System**
>
>   d.   **Provide ITAM System access to other City divisions (where required) including adequate training to assist them in understanding the system.**

A.2.   Acquisition of Hardware and Software in Excess of Needs

A.2.1.   Bulk Purchased Computers Languished in Storage for Over 20 Months

3,500 desktops were purchased at a cost of $1.9 million in December 2015 and 1,440 computers were still in stock as of September 2017

In December 2015, the I&T Division purchased 3,500 desktop computers at a cost of $1.9 million. When we performed this audit in September 2017, 1,440 of these computers were still in stock at the vendor's warehouse. This is one year and eight months after the original purchase, by which time the assets have started to become obsolete and have already lost one third of their useful life based on the City's five year replacement cycle for its computers.

During the course of this audit, we were advised that 909 desktops were still at the vendor's warehouse in April 2018. In May 2018, the I&T Division further advised us that 671 desktops from the vendor's warehouse were being deployed, leaving an inventory of 238 desktops at the vendor's warehouse.

The I&T Division informed us that the bulk purchase of these computers was done to avoid software compatibility problems expected with certain City divisions' legacy systems when Microsoft's new Windows operating system was to be implemented in October 2016.

Business case identifying the number of computers required by each division was not available

The I&T Division did not have a formal business case detailing the number of computers required by each division or a deployment plan to justify the purchase of this many computers. While it appears the City acquired these assets at a good price, idle assets at any price are not a bargain.

City incurred $75,000 storage cost

In addition to the cost to acquire the computers, the City paid $75,000 to store the desktops at the vendor's warehouse.

In a deployment of computers at one division, we noted the I&T Division replaced 77 computers before their normal replacement cycle. The logic behind this was to put all staff in the business unit on a level playing field. This was meant to prevent a need for IT staff to reconfigure older computers with new applications, and was expected to reduce maintenance costs.

Management had plans to re-deploy these computers to other units in the division. However, we did not find a formal detailed re-deployment plan prepared in advance of replacing these computers. Having a detailed plan before decommissioning computers would ensure that such computers are appropriately accounted for and repurposed in a timely manner.

A.2.2. Monitoring Extra Computers at City Divisions

The ITAM System has records on more than 27,000 computers

As of September 2017, the City had an inventory of 27,164 computers (desktops, tablets, and notebooks) in the ITAM System. These computers were deployed at various City divisions. Our analysis of the City's computer inventory identified that City divisions may be carrying extra computer inventory.

We noted that there are about 2,700 computers that are not allocated to specific users, representing eight per cent of the total registered users within the City. These computers include spares, secondary and shared computers. There is a need to perform a validation as to whether these computers are needed, and any excess computers should be repurposed.

> **Recommendation:**
>
> 2. **City Council request the Chief Information Officer to:**
>
>   a. **Develop a process for monitoring and reporting of "in stock" assets and their respective costs. Reporting should be made available within the I&T Division and other City divisions to review the availability and age of IT assets for consideration of deployment before making new purchases**
>
>   b. **Ensure that all high-volume purchases of IT assets are supported with an appropriate deployment plan**
>
>   c. **Develop a process for performing a periodic review with City divisions that have IT assets which are not deployed or assigned to users to address any excess inventory.**

B. PROBLEMS WITH EXTENT AND TIMING OF SOFTWARE ACQUISITIONS

B.1. Improved Project Due Diligence and Implementation Planning is Required

The City manages approximately $3 billion in spending for goods and services annually

The City manages approximately $3 billion in spending for goods and services annually. The SAP software program, the Enterprise Resource Planning (ERP) solution, is what the City uses to manage and meet its needs.

In 2007, the City acquired licences for a SAP procurement module. The City encountered difficulties implementing the module. In 2014, a third party assessed the module against the City's existing procurement process for implementation. Based on this assessment, City staff estimated $27 to $30 million would be needed for the implementation. This was well beyond what the City was willing to pay to meet its needs in this area.

In 2016, the City decided to purchase SAP Ariba cloud solution for its supply chain management processes

As a result, in 2015, the City decided not to implement the acquired solution and instead proceeded with the search for alternative solutions that could meet the City's need for an end-to-end supply chain management at a lower cost. In 2016, the City decided to purchase SAP Ariba cloud solution to meet its needs.

The City incurred $4.7 million during nine years on software that was never implemented

From 2007 to 2016, the City spent $4.7 million on SAP Procurement module that was never used. This is composed of $2.3 million in initial licences purchased and $2.4 million in maintenance costs for over nine years.

With that chapter of the supply chain solution story behind them, staff moved forward with the Ariba solution.

In October 2016, after obtaining the Council's approval, the City entered into a five-year agreement with SAP for the use of the SAP Ariba cloud solution. During the SAP Ariba cloud solution contract negotiation, the I&T Division advised that they were able to get credit, over the five year agreement, for the $4.7 million spent on the previous solution that was never implemented. The staff report to the City Council is available at:

https://www.toronto.ca/legdocs/mmis/2016/gm/bgrd/backgroundfile-92559.pdf

Not possible to verify whether $4.7 million credit was actually recovered

We can see that the City was given a credit equal to $4.7 million on the purchase of the Ariba software. However, because of the nature of the software pricing, we were unable to verify that the 4.7 million credit was received i.e., if the net price paid for the Ariba software could have been achieved irrespective of the City's situation related to the prior costs of $4.7 million.

Regardless, the SAP Ariba cloud solution was planned to be implemented throughout in stages over about a year as it involves the implementation of a number of modules.

The SAP Ariba project's implementation is delayed

Currently, the project's implementation is delayed. We have been advised by the project sponsor that a new plan has been prepared which includes the revised implementation timelines. The original implementation timelines for the different modules ranged from Q3 2017 to Q2 2018, and the new recast timelines are from Q2 2018 to Q3 2019.

It appears the City will pay $2.5 million in subscription costs, but it will not receive the intended benefits for the period of delay

It appears the City will pay $2.5 million in subscription costs for the period of delay, but it will not receive the intended benefits. Our estimate includes SAP Ariba cloud solution subscription costs only, and does not include the cost of the staff resources related to the delay.

Table 1 provides details of implementation delays and associated subscription costs.

Table 1: SAP Ariba Cloud Solution Subscription Cost for the Period of Implementation Delay

SAP Ariba Modules and Components	Original Implementation Timeline	Revised Implementation Timeline	Delay in Months	Subscription Costs for the Delayed Period
Module #1	December 2017	July 2019	19	$1,600,800
Module #2	September 2017	May 2018	8	$151,000
Module #3	October 2017	September 2018	11	$107,000
Module #4	October 2017	September 2018	11	$235,000
Module #5	February 2018	July 2019	17	$330,300
Module #6	May 2018	March 2019	10	$79,100
TOTAL				**$2,503,200**

Management advised us that the implementation challenges from the SAP Ariba cloud solution have helped the City to identify the need to change its historic implementation approach. Solutions implemented in the cloud require extra considerations, such as the need to execute testing while implementing, instead of testing at the end of the implementation.

Management advised its project governance process has been improved

Management also advised us that its project governance process has been improved. The existing process includes a thorough evaluation of business needs by the Business Executive Committee, Strategy & Portfolio Review Committee and Project Review Team. All new IT projects undergo a review by these committees.

B.2.   Multiple Situations Exist Where Costs are Incurred for Unused Licences

The following table summarizes software licences for various applications that are currently unused, while the City is responsible for both the initial licence cost and ongoing maintenance. Table 2 provides details of the acquisition of unused SAP licences and annual maintenance costs incurred as of January 31, 2018.

Table 2:   Unused SAP Licences Acquisition and Annual Maintenance Costs Incurred as of January 31, 2018

Application Name	Licence Inventory	Licence Usage	Unused Licence Inventory	Acquisition and Annual Maintenance Costs
SAP Application # 1	581	482	99	$588,700
SAP Application # 2	2,477	2,192	285	$119,900
SAP Application # 3	569	459	110	$81,800
Employee Self-service	18,924	5,299	13,625	$315,800
Total Acquisition and Annual Maintenance Costs				**$1,106,200**

There are different circumstances behind each of the items listed in the table above.

B.2.1.   Excess SAP Licences (Applications 1, 2 and 3)

Three SAP solutions have unused licences with acquisition costs of $647,900 and annual maintenance costs of $142,500

We found three SAP solutions that have unused licences with acquisition costs of approximately $647,900 and annual maintenance costs of $142,500. The I&T Division staff advised us that these extra licences are kept for contingency purposes. The extra licences should be periodically reviewed to maintain an optimum level of contingency. The number of extra licences should be adjusted based on monthly usage.

B.2.2. Excess Employee Self-service Solution Licences

In 2007, the City purchased SAP Employee Self-service solution licences. These licences were not implemented until 2012 for non-union staff. In 2012, additional licences were purchased to support the future delivery of electronic payroll services to all other City staff.

$543,600 incurred for unused Employee Self-service licences acquisition and maintenance costs

As of January 2018, 72 per cent of these licences remained unused. The City has incurred an aggregated expenditure of $543,600 on these unused licences, composed of the acquisition and five-year maintenance costs.

The adoption and plan to deliver electronic payroll services to all City staff did not happen as expected

Management has advised us that these licences were purchased at a discounted price and with the expectation that they would be used for the future delivery of electronic payroll services to all City employees. However, the adoption and plan to deliver electronic payroll services to all City staff did not happen as expected.

City staff who do not have a work computer or remote access to the City's network cannot use the electronic payroll services. The Pension, Payroll & Employee Benefits Division is currently working on a business case to provide employees with remote access for electronic payroll services.

The issues described are a clear indication of deficiencies in the diligence process

The issues described above are a clear indication of deficiencies in the diligence conducted for the acquisition of these licences because they were purchased without an immediate demand and plan for adoption.

The City could have reduced its cost of $1.4 million in printing and distributing pay stubs over 5 years

Had the Employee Self-service solution been implemented on a timely basis, the City could have also reduced its cost of $1.4 million in printing and distributing pay stubs from 2013 to 2017. Implementing the remote access solution will save $280,000 annually on printing and distribution of pay stubs.

The I&T division needs to report out on unused software licences

The unnecessary costs reflected in Table 2 highlight the need for due diligence in licence acquisition and ongoing monitoring to minimize incurring costs for licences that are not used.

SAP Licences are monitored by the I&T Division and usage reports are provided to City divisions monthly. These reports are escalated to the Finance and Accounting Coordination Team, chaired by the Treasurer for Information. There is a need to enhance the existing reporting procedure to include the accumulated financial impact of unused licences, and thresholds need to be set to ensure excessive unused licence situations are flagged and resolved.

Recommendations:

3. City Council request the Chief Information Officer to develop a reporting mechanism and criteria for reporting to the Executive Modernization Committee and respective Executive Project Sponsors on project implementation delays and unused software licences with reports to include as a minimum:

   a. Accumulated financial impact of delays

   b. Unused assets, licences and solutions

   c. Forgone benefits as a result of project implementation delays

   d. Plans in place to mitigate the impact of delays.

4. City Council request the Chief Financial Officer to coordinate with the Executive Director of Human Resources and Chief Information Officer to:

   a. Expedite the adoption of the SAP Employee Self-service solution throughout the City to maximize licence use and save costs incurred from printing and distribution of pay stubs

   b. Review the existing IT environment to evaluate options to allow staff that do not have a work computer to have access to Employee Self-service solution.

C. MIGRATION FROM PHYSICAL SERVERS TO CLOUD SERVICES OR VIRTUAL SERVERS TO REDUCE COSTS

In the past, the City, like most organizations, serviced most of its significant computing needs with its own physical servers. These servers were, and are, used for most City applications and also for web services that allow the public to interact with the City.

In recent years, there has been a move away from physical servers to either cloud services, or virtual servers to reduce costs

In recent years, there has been a move away from physical servers to either cloud services where servers are maintained by third-party providers, or virtual servers where a software-based computing environment is created to reduce the number of physical servers. Both of these solutions have generally become more cost effective than traditional physical servers.

Savings of $7,500 to $20,000 can be achieved by converting one physical server to a virtual server

The City's IT environment consists of approximately 999 physical servers, of which 494 servers are managed by the I&T Division and the remaining 505 servers are managed by other City divisions. In an analysis performed by the I&T Division, we noted that savings of $7,500 to $20,000 can be achieved by converting one physical server to a virtual server.

While good progress has been made towards virtualizing the City's IT environment (187 virtual hosting servers have been put in place to replace physical servers), there is a need to perform a City-wide review of how the existing number of physical servers can be further reduced and/or switched to a virtual or cloud environment.

In our Phase 1 report, we recommended strengthening the role of the CIO to have authority over other City divisions, agencies and corporations and establishing a Strategic Technology Roadmap to identify opportunities for improvement in the IT infrastructure. We understand our recommendations are being implemented and this should accelerate the move to alternate service delivery platforms, allowing the City to reduce costs and improve services.

The cloud solution is currently used primarily for the City's main web content

The City entered into an agreement with a cloud service provider in April 2017 to manage its main web content found at www.toronto.ca. The online cloud service is provided under a consumption-based pricing model, which means that the City will be invoiced on a pay-per-use basis. The current average monthly consumption of services is approximately $13,000. Various other City divisions have expressed interest in using the online cloud service provider for their own business needs.

Procedures need to be implemented for divisions to monitor their consumption to avoid risk of unforeseen high payments

The I&T Division needs to implement controls and processes to ensure a cloud solution is appropriate for each request for cloud services given the current and anticipated future usage for each service. The resulting analysis is effectively a business case supporting the eventual decision. In all cases, procedures need to be implemented for divisions to monitor their individual services and consumption to avoid risk of unforeseen high payments and excessive costs due to the consumption-based pricing model.

> **Recommendations:**
>
> 5. **City Council request the Chief Information Officer to conduct an assessment of the City's existing physical servers for identification of opportunities for adoption of cloud services and/or virtualization.**
>
> 6. **City Council request the Chief Information Officer to implement ongoing monitoring of cloud consumption levels by divisions to ensure any necessary adjustments to the service delivery model are identified and implemented on a timely basis to avoid incurring excessive costs.**

D. SUPPORT AND MAINTENANCE OF CRITICAL NETWORK ASSETS

Having back-up measures for critical network assets is important

The City's network infrastructure is the foundation for providing efficient and effective delivery of information and services. The network must be always available for an uninterrupted delivery of information and services. As such, it is very important for the City to have back-up measures for its critical network assets.

The I&T Division provides leadership and is responsible for a City-wide maintenance and support contract for the network assets. The contract is also for providing sufficient protection and redundancy to ensure there is no significant network downtime.

In some cases, City divisions make their own arrangements for support, maintenance and back-up. It is likely that reliability and cost effectiveness could be enhanced by including most, if not all, City network assets in the I&T maintenance and support contract.

The I&T Division's existing process requires improvement to indicate to other City divisions what their responsibilities are when it comes to including their critical network assets in the City-wide maintenance and support contract.

> **Recommendation:**
>
> 7.   **City Council request the Chief Information Officer to formalize criteria to identify critical network assets to be covered by the corporate support and maintenance contract and communicate to the responsible divisions the advantages of inclusion in the City contract.**

E.   RELEVANCE TO AGENCIES AND CORPORATIONS

Relevant audit findings should be shared with agencies and corporations

Although agencies and corporations were not within the scope of our audit, this report contains a number of findings and recommendations that are also relevant to them to leverage economy of scale, to improve efficiency and to achieve cost savings.

The CIO, through the City Manager, should share relevant audit recommendations with major City agencies and corporations. Any resulting IT strategy, policies, procedures, and standards should be provided to agencies and corporations for consideration.

Management staff in each of these organizations should review the issues and recommendations in this report, consider the relevance to their respective organizations, and provide any necessary reports to their governing body.

> **Recommendation:**
>
> 8.   **City Council request the City Manager to forward this report to the major agencies and corporations for their review and consideration of the relevance of the recommendations to their respective organizations.**

CONCLUSION

This report highlights a number of key issues that need to be addressed by the I&T Division and other City divisions as a whole. As noted in previous Auditor General reports, there continue to be instances where significant costs are incurred for software assets that are not used on a timely basis. Better controls over acquisition and ongoing monitoring would lead to reduced costs for the City.

There are also opportunities to realize efficiencies and cost savings by moving away from City-operated physical servers to either virtual servers or cloud service delivery solutions.

Report makes eight recommendations to enhance IT asset management

This report includes eight recommendations to improve IT asset management, reporting on unused assets and licences, and to ensure project delays are measured in terms of financial impact and benefits forgone.

AUDIT OBJECTIVES, SCOPE AND METHODOLOGY

The Auditor General's 2017 Audit Work Plan included a review of information technology infrastructure and assets managed by the I&T Division.

Audit objective

The objectives of this review were to identify potential opportunities to optimize costs and enhance the operational efficiency of the IT infrastructure and asset management.

Methodology

Our audit methodology included the following:

- Meetings with the staff of the I&T Division and various other City divisions
- Review of various IT projects and initiatives
- Identification of in-scope IT networks, systems and applications
- Understanding the City of Toronto network infrastructure through the review of documented material and interviews with key staff
- Analysis of data obtained from IT asset management system and other IT systems
- Other procedures, as deemed necessary

Compliance with generally accepted government auditing standards

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient and appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Exhibit 1: Glossary of Terms

Term	Description
Cloud Computing	An information technology model that enables access to shared pool of IT systems and resources that can be acquired through service providers and often adopted over the internet.
	Cloud computing can be compared to public utilities used to deliver commodities such as gas, water or electricity. Instead of acquiring and operating IT systems and applications, computing infrastructure, such as storage, servers and computing power is purchased from the utility (Service) provider.
	Additional information is available on Government of Canada website: https://www.canada.ca/en/treasury-board-secretariat/services/information-technology/cloud-computing/government-canada-cloud-adoption-strategy.html
Computer Network commonly referred as "network"	A collection of IT assets connected together either through physical wiring or wirelessly.
Corporate Network	A group of IT assets connected together, which are part of a company's IT infrastructure, and abide by the same corporate policies, standards and procedures.
Firewall	A security system that monitors and controls incoming and outgoing internet/data traffic based on specified security rules, such as unauthorized access to/from a specific network.
Hardware	Refers to the physical aspect of networks, telecommunications, and other devices, such as a computer, a hard disk, a monitor or a telephone.
IT Asset	The units or individual elements of information, software and hardware that are used in the course of business activities, which are the foundation of the IT infrastructure.
IT Asset Management (ITAM) System	Refers to the software application that enacts a set of business practices that join financial, contractual and inventory functions to support lifecycle management of IT assets and strategic decision making for the IT environment.
IT Environment	The specific conditions of an entity's IT infrastructure, software, people, procedures, and data necessary to perform a function or provide a service.
IT Infrastructure	Refers to the physical structures, IT software and other hardware, for example, computers, equipment, mobile devices, network and telecommunications devices that are required for the existence, operation and management of an enterprise IT environment.
Network Switch	A network device used to connect multiple devices on the same computer network.

Term	Description
Operating Environment	Refers to the IT environment supported by an IT infrastructure in which services can be provided and application software can be run.
Router	A network device that forwards data between computer networks. Routers can perform traffic directing functions over the internet and corporate networks until data reaches the intended destination.
Server (also referred as Physical Server)	A computer, usually more powerful and advanced in comparison to regular user computers, that provides services to other computers.
Software	A computer program that consist of specific instructions to perform intended functions in a computer environment.
Secondary, Shared and Spare Computers	Secondary Computers – Computers used as in addition to the primary device allocated to user. An example is City staff with desktop as a primary device and a laptop as a secondary device.
	Shared Computers – Computers that are shared by more than one City staff.
	Spare Computers – Computers that are kept by divisions as extra for emergency or mobility purposes.
Technology Lifecycle Management (LCM)	An approach that encompasses the planning, design, acquisition implementation, decommission and management of all the elements of the IT infrastructure, including data, applications, and corporate devices.
Technology Roadmap	A technology roadmap is a plan developed to achieve short-term and long-term goals. It usually considers specific technology solutions to help meet those goals.
	Developing a roadmap has three major uses: it helps reach a consensus about a set of needs and the technologies required to satisfy those needs, it provides a mechanism to help forecast technology developments, and it provides a framework to help plan and coordinate technology developments.
Virtualization/ Virtual Hosting Servers	Virtualization is the process of creating a software-based computing environment (also referred as virtual servers) to reduce the number of physical computers.
	Several virtual servers can be implemented on one server as a virtual host.

APPENDIX 1: Management's Response to the Auditor General's Report Entitled: "Information Technology Infrastructure and Asset Management Review: Phase 2: Establishing Processes for Improved Due Diligence, Monitoring and Reporting for Effective IT Projects and Asset Management"

Recommendation 1: City Council request the Chief Information Officer to:

a. Develop a process to ensure timely synchronization of IT asset purchases recorded in SAP with IT Asset Management (ITAM) System records

b. Expedite reconciliation of network assets and update them in the ITAM System

c. Develop secure communication mechanisms (or an alternate process) to allow for the update of segregated networks' IT assets in the ITAM System

d. Provide ITAM System access to other City divisions (where required) including adequate training to assist them in understanding the system.

Management Response: ☒ Agree   ☐ Disagree

Comments/Action Plan/Time Frame:

An Asset Management Task Force was established in November 2017 to address the concerns raised in various Auditor General's reports. Target implementation dates provided are preliminary and are subject to further validation.

a. A process will be developed by Q1, 2019. Implementation plan of the process by Q1, 2020.
b. Complete implementation for updating network devices information in IT assets management system by Q4, 2019.
c. A plan will be developed by Q2, 2019 based on existing process in place for segregated networks.
d. Once validation of business requirements are identified from the divisions by Q4, 2019 then Training plan will be developed Q2, 2020.

Recommendation 2: City Council request the Chief Information Officer to:

a. Develop a process for monitoring and reporting of "in stock" assets and their respective costs. Reporting should be made available within the I&T Division and other City divisions to review the availability and age of IT assets for consideration of deployment before making new purchases

b. Ensure that all high-volume purchases of IT assets are supported with an appropriate deployment plan

c. Develop a process for performing a periodic review with City divisions that have IT assets which are not deployed or assigned to users to address any excess inventory.

Management Response: ☒ Agree   ☐ Disagree

Comments/Action Plan/Time Frame:

a. Subject to the Asset Management Software (HPAM) enhancement/cleanup, the reporting target is expected by Q1, 2019.
b. Target completion date Q4, 2018
c. Subject to the Asset Management Software (HPAM) enhancement/cleanup and Chief Information Officer authorization, the reporting target is expected by Q2, 2019.

Recommendation 3: City Council request the Chief Information Officer to develop a reporting mechanism and criteria for reporting to the Executive Modernization Committee and respective Executive Project Sponsors on project implementation delays and unused software licences with reports to include as a minimum:

a. Accumulated financial impact of delays

b. Unused assets, licences and solutions

c. Forgone benefits as a result of project implementation delays

d. Plans in place to mitigate the impact of delays.

Management Response: ☒ Agree ☐ Disagree

Comments/Action Plan/Time Frame:

The I&T Division will develop a reporting mechanism and criteria to ensure accountability associated with project implementation delays, financial impacts and mitigation strategies. Reports will be presented to the Executive Modernization Committee (currently in development). The reporting frequency is to be determined as an element of the modified governance framework.

Recommendation 4: City Council request the Chief Financial Officer to coordinate with the Executive Director of Human Resources and Chief Information Officer to:

a. Expedite the adoption of the SAP Employee Self-service solution throughout the City to maximize licence use and save costs incurred from printing and distribution of pay stubs

b. Review the existing IT environment to evaluate options to allow staff that do not have a work computer to have access to Employee Self-service solution.

Management Response: ☒ Agree ☐ Disagree

Comments/Action Plan/Time Frame:

The Pension, Payroll and Employee Benefits Division (PPEB) is working with Employee Relations and IT to expand the usage of Employee Self Service (ESS) to more employees in the City including employees with no access to a work computer. PPEB will be also exploring avenues to make ESS mandatory for all City employees. Target completion date by Q3, 2020.

Recommendation 5: City Council request the Chief Information Officer to conduct an assessment of the City's existing physical servers for identification of opportunities for adoption of cloud services and/or virtualization.

Management Response: ☒ Agree   ☐ Disagree

Comments/Action Plan/Time Frame:

Technology Roadmap to be developed by a third party professional services firm by Q3, 2018. This will allow I&T to establish a holistic approach to the technology direction for the City.

I&T to conduct an assessment of the City's existing physical servers to identify the opportunity for adoption of cloud services or virtualization and prepare a plan to the CIO, by Q2 2019.

Recommendation 6: City Council request the Chief Information Officer to implement ongoing monitoring of cloud consumption levels by divisions to ensure any necessary adjustments to the service delivery model are identified and implemented on a timely basis to avoid incurring excessive costs.

Management Response: ☒ Agree   ☐ Disagree

Comments/Action Plan/Time Frame:

Controls and process currently in place will be enforced with a target completion date by Q4, 2018.

Recommendation 7: City Council request the Chief Information Officer to formalize criteria to identify critical network assets to be covered by the corporate support and maintenance contract and communicate to the responsible divisions the advantages of inclusion in the City contract.

Management Response: ☒ Agree   ☐ Disagree

Comments/Action Plan/Time Frame:

I&T will publish a guideline on ITWeb for Division as guideline to assist them to determine criteria to identify devices to be covered by the Corporate network devices maintenance contract by Q4, 2018.

Recommendation 8: City Council request the City Manager to forward this report to the major agencies and corporations for their review and consideration of the relevance of the recommendations to their respective organizations.

Management Response: ☒ Agree   ☐ Disagree

Comments/Action Plan/Time Frame:

The City Manager will forward the report to the identified agencies and corporations for review by Q3, 2018.