



UNIVERSITY OF
WATERLOO

Campus Information Technology Review

Final Report

May 27, 2020

Acknowledgements

The constantly changing landscape that is information technology rarely affords an opportunity to pause and consider its alignment, ability and importance in supporting an organization's mission. Information technology is pervasive, and in the world of higher education, supports the running of a 'small city'. Along with the people and processes that make up the everyday activities of the organization, it is part of a vast support network that enables UW in its core missions of teaching, learning and research.

This review has been one of those unique chances to consider our current position and ways we might improve. The campus IT community is represented by a diverse and distributed group of dedicated professionals who provide IT services - developers, project managers, system analysts, help desk staff and many more. The consumers of those services are equally diverse - students, instructors, researchers, staff, alumni, retirees, community members and other. Their interactions with IT might occur daily and be largely routine as in the case of wireless access, or once a term for more complex activity as in the case of coop interview scheduling. Different patterns of familiarity and complexity can prove challenging to users and providers alike. All rely heavily though on our infrastructure, systems and services. That reliance has never been more apparent than right now, as the campus navigates the COVID-19 pandemic.

Throughout the many consultations, all those involved demonstrated a keen interest in supporting the campus community and finding ways to improve. Discussions were forthcoming, open and very much in the spirit of making things better. Participants brought with them their unique perspectives based on their role at the university and involvement with technology, as well as the culture and capability of their respective units. While highlighting examples of individual priority and local need, all emphasized the possibilities found in and importance of working together. The committee would like to thank all of those who took the time to provide feedback through the many internal workshops, external interview sessions and in other forms.

We would also like to thank our external reviewers, Bo Wandschneider and Sean Reynolds. Their experience, at an international level and in Canadian Higher Education, was invaluable in eliciting the same quality feedback from those who took part in the external review sessions. Their thoughts and recommendations provided an important independent perspective and lens through which the committee was able to further validate and emphasize its overall findings.

I would also like to personally thank the members of the Steering Committee, who eagerly took on the task of absorbing a small mountain of material and feedback, despite already busy schedules. Their deliberations were fulsome and thoughtful, and ultimately achieved broad consensus on several key calls for action.

The end result is a set of significant and challenging steps for the campus to consider, but ones which have the ability to make a very positive change in Waterloo's IT landscape and service to the campus.

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1. Executive Summary

Introduction

The IT landscape at Waterloo is one characterized by its scope, complexity, and vital role in enabling research, teaching, learning and support of core business operations and administration. Waterloo's reputation for innovation and strength in STEM disciplines naturally brings greater expectations and scrutiny on its information technology capability.

At no time has that reliance and importance been more apparent than today; the Covid-19 pandemic has provided a very real demonstration. IT staff are involved in system and service options for work from home, alternative methods for course delivery and assessment and other contingencies in cooperation with campus partners. These efforts have demonstrated the resilience of this key university resource and its ability to respond to critical demands. This crisis has also shown the importance of working with common purpose to solve problems. The situation has also highlighted the challenges and gaps that are present in our overall IT space and confirmed a number of priorities and opportunities for improvement identified during the review. These include the ability to access important data and other knowledge and information quickly, configurable and connected administrative applications, a robust network and like infrastructure, tools that enable collaboration and work from a distance, and a community that works as one.

Mandate

Our purpose was to determine where the delivery and value of IT services on campus could be made better for the benefit of the institution. Important aspects included identifying opportunities to enhance efficiency and effectiveness, improve user experience, minimize risk to the organization, reduce duplication or find gaps in services, provide clarity regarding roles and responsibilities and respond to new internal and external pressures. At a high level, the community was asked what we do well, not so well and priorities for change, with more detailed questions posed in interviews and workshops.

The committee met regularly beginning in May 2019 and gathered information on our current state, approaches and practice from peers in higher education and relevant changes or trends in the broader technology world. The process involved individual interviews and a series of internal workshops on specific topic areas, such as information, administrative systems, infrastructure, research, teaching and learning and supporting services. It also involved an external review, led by Bo Wandschneider, CIO at the University of Toronto and Sean Reynolds, VP for Information Technology and CIO at Northwestern University, who had the opportunity to meet with a wide range of stakeholders. The review did not specifically include IT services provided by the Affiliated and Federated Institutions.

Findings

Governance was an important topic for many. A pre-requisite for other improvements, there is a strong need for a simplified structure which can provide visibility and efficiency in decision-making, prioritization, determine principles and practice, and ensure support for IT groups and staff. The objective is one of clarity and an approach which allows people to work together more productively by fostering an 'IT community' philosophy. A renewed vision and direction are also needed, and should be reflected in the development of a new strategic plan for IT. These would address principles related to innovation and differentiation, specific initiatives and overall elements of

planning and funding. This reflects the frequently noted sentiment that Waterloo has significant strength and resource in its people and problem-solving, but can be lacking in planning and processes to support them.

Our infrastructure received high marks overall. Improved service for research activity was broadly supported; a unified suite of core services would build on the important local IT connection with researchers. A significant period of renewal in our information systems has eliminated the applications debt that existed; improvements can be made with respect to user experience, integration, agility and planning. The multi-dimensional community which currently provides support for teaching and learning would benefit from broader participation from instructors and students and a more comprehensive planning and funding framework for educational technology. Data and its role in supporting operations and decision-making was frequently referenced; policy, access, definition and tools were commonly heard needs. Certain areas, such as training and security, received relatively light comment. In the case of training, this is most likely due to the comprehensive set of services available; this area warrants continued emphasis and support. While input regarding security was less than expected, this may also be due to the confidence staff have in our current capability. A recent major incident at a large local university emphasizes the need for ongoing attention, however. Protecting against threats to privacy, data and intellectual property will require ongoing and even greater diligence; identifying gaps, specific mitigations and promoting an overall sense of community responsibility will be necessary.

The internal and external sessions were consistent in their feedback. Our external reviewers suggested the need for improved governance, clarification of roles and responsibilities including the senior IT role, a more unified approach to IT overall, a new strategic plan, emphasis on security, a better match for administrative applications with user requirements and their experience, core research supports, an enhanced framework for teaching services, as well as specific opportunities for communication and staffing. Many findings also align with other campus exercises; a more complete knowledge management capability has been frequently noted as a priority. The principle of sustainability, which manifests in many ways, should be a strong consideration moving forward. The interaction between IT and other functions or services must also be considered. These relationships are found in the connection between general classroom maintenance and technology, data stores and information policy, information systems and business processes or WIFI needs for specific lab spaces; all speak to the need for early involvement in initiatives, joint planning and awareness of overall user experiences that cannot be dealt with in isolation.

Direction

There have been three technology reviews over the past 20 years, including the 2003 IT External Review on Teaching, Learning, Admin and Research, 2009 IT Internal Task Force Review and 2013 IT Strategic Plan. The period encompassed by these exercises was marked by a number of key changes in IT, including the rapid growth of handheld technology, online learning spaces and e-commerce. In more recent years, the advent of cloud systems and services, greater compliance considerations, focus on privacy and security and the emergence of big data and related disciplines have shaped campus IT directions.

Notwithstanding these changes and new needs, there are notable similarities between this review and its predecessors. These include fundamental and foundational aspects related to governance, the security and integrity of data and information, a full appreciation and understanding of the needs of our stakeholders, roles and accountabilities, working well together and a university-wide approach to technology services; the committee's key findings reflect these

persistent challenges. The continuity of feedback over time is an indicator of their importance to staff, faculty and students. A firm commitment to progress in these areas will be needed for Waterloo to build on an already strong base, adapt to unforeseen events, remain competitive, support the 2020-2025 Strategic Plan and ensure a robust information technology capability in the coming years.

Recommendations

1. Ensure agile and effective decision-making

The university should adopt a well-defined governance, planning and execution model for IT that allows for clear and efficient decision-making, provide necessary direction and a supportive framework that leverages the strengths of both central and distributed IT staff and resources.

This will require the development of a new vision, risk framework and 5-year strategic plan for information technology, a streamlined committee structure with the necessary authority and accountabilities and a community approach to IT which promotes working together in a purposeful and coordinated manner.

2. Advance learning and research

In alignment with our academic mandates and mission, the institution should provide a more robust and enhanced IT capability in support of teaching, learning and research activity.

This will involve the creation of a common and core suite of services for researchers, an enhanced framework for the full lifecycle of education technology and additional support for both classroom learning and online instruction.

3. Enhance support for the campus community

In order to support the increasing complexity of our administrative functions and academic pursuits, the university should enhance its position and make specific improvements with respect to administrative systems, data and security.

The priority initiatives to achieve this include a multi-year roadmap for administrative information and collaborative systems which addresses integration, user needs and experience; improved access to and use of data through governance, training, tools and infrastructure; an identification of and strong focus on specific gaps or needs related to security and the protection of data, privacy and intellectual property.

By focusing on these challenges, we are confident that many of the specific concerns or opportunities brought forward during the review will also be addressed. As an initial and immediate need, we recommend that the question of governance be prioritized. At a high level, we envision a reconstituted university-wide steering body which would take ownership of a new strategic plan and risk management. Reporting to this group would be bodies devoted to administrative systems, teaching and learning, research and infrastructure, which would then assume responsibility for advancing the appropriate recommendation. A revised AIGC, in its new role as steering body for the Data as a Strategic Resource program, would be responsible for advancing recommendations related to data.

2. Background and Purpose

Periodic reviews of major functions are important from a diligence perspective and a large component in ensuring their alignment with campus needs; a comprehensive look at IT was particularly relevant at this time. Internally, the IT 2013-2018 Strategic Plan had run its course and the new UW 2020-2025 Strategic Plan was nearing release to the UW community. It was, therefore, an appropriate time to establish key directions for IT activity in major technology units and partners across campus in the coming years. There were also a number of changes in senior leadership, within faculties and senior administration, where new needs and requirements could be considered. New financial pressures from funding changes at the provincial government level also meant that a thorough look at this large investment of human capital, in software licensing and approaches to efficiencies or duplications was important.

The review was conducted in two main streams. An internal review consisted of exploratory workshops on specific functions and also those with a focus on students, researchers and instructors. The external review allowed for an independent lens in peer-oriented interviews. The findings from all of these were then combined and analyzed, with the Steering Committee pulling together a consolidated set of recommendations. The review focused on capability and service, while acknowledging the organizational aspects and units who contribute daily.

The review was structured as intentionally broad; IT services are provisioned from many walks on campus, whether in faculties or academic support units. Individuals, such as developers, may hold a more traditional role; others, such as data analysts, may be in an emerging role with strong links to IT. Some staff, as might be the case in smaller units, may have a part-time role in areas such as local desktop support; all are important in the IT ecosystem. From a user perspective, it often matters less where service is provided or by who, only that the service efficiently and promptly meets their needs and that the path to gaining support, whether virtual or in person, is clear. The broad scope also reflected the integrated nature of technology in today's world. The review was able to consider more detailed initiatives or services as well, including migrations within the O365 environment with its collaborative and productivity tools, the new Nexenta and upgraded Netapp storage solutions, or Accuro Electronic Medical Records implementation for Campus Wellness. The review was a chance to reflect on these and identify both specific changes and those that might span many functions.



The Steering Committee recognizes that at the time of writing, the university is dealing with an unprecedented situation, including the physical closure of much of the campus and resulting impact. As a result, we appreciate that the priority associated with our recommendations and details within will need to be assessed in that context, along with other important activities and operational concerns associated with the 2020 Spring and Fall terms and broader implications for resources and finances. We assume that, regardless of recommendations made here, that there will be ongoing and summative reviews from the COVID-19 experience to assess remote learning support, infrastructure change and any like capabilities, in conjunction with any university-wide studies and analysis.

3. Major Recommendations

Overall Theme

The University of Waterloo community would be well served by developing and articulating a common vision for and embarking on a more holistic approach to IT. An overarching strategic plan, re-envisioned governance, and clarity of roles would build on our extensive current capabilities, existing collaborative efforts and strength in people and systems. It would also improve efficiency in processes, foster working relationships, and eliminate the lack of clarity and sometimes friction that exists when advancing IT functionality and delivery. The overarching goal is to better serve our user community, build on Waterloo's strength of resources to more purposefully integrate the activities of the central and distributed units and staff through a more federated approach.

The recommendations that follow should be viewed through a number of important lenses, including the impact, needs, user experience and importance of our many campus stakeholders, including students, faculty, staff and other. A perspective that permeates all theme areas is that of risk and security. These are noted as specific actions as well, but are important vantages with which the community should consider changes at this time. Throughout, evidence reveals much in our IT capability that does work well. The ability of the community to rapidly scale collaboration services such as MS Teams, deploy enhanced academic services as with EngLab, and quickly acquire new technology for electronic signatures with Notarius or improved access to resources with Alibaba VPN for students in China, all speak to fundamental strengths. The new Waterloo Ready initiative will leverage Learn, online conferencing, live chat and other tools.

While the full impact of the pandemic is yet to be known in terms of budget, academic delivery, research efforts and potential administrative changes, there are aspects or areas which will likely require attention. These include a focus on the 'online experience', whether for access to software or academic content and resources for students or student services. There are similar implications for faculty and staff. The need for agility and adaptability has also been reinforced. Recently announced enhancements for students and community interested in lifelong learning demonstrate the need for IT to react quickly to changes in offerings and practices. This may require an approach where solutions are considered less ideal endpoints and more milestones along the way. It will also require fewer expectations for perfection in the interest of progress and 'getting things done'. These will, of course, need to be balanced with the need for consultation, reliability and people's ability to absorb change and need for some consistency in their work and academic environment.

Intent and Rationale

The committee received a wealth of feedback from participants, gathered in both internal discussions and the external review that was conducted. These were frank, open and forthcoming and in the appropriate spirit of improvement. Many possible recommendations were presented, including some very detailed or specific, which might be considered moving forward. While there were a number of unique and individual perspectives on current state and possible detailed courses of action, there was broad consensus in virtually all areas on the most important steps and priorities.

In forming its recommendations, the committee has chosen to promote a limited number. These reflect the highest priority and most commonly cited areas in need of attention. It was felt that by focusing on these key areas, we will not only address these important priorities, but also by consequence improve and support substantive progress for the other challenges noted during consultations. Details are reflected in the key elements of each recommendation; some of these represent shorter-term improvements that might be made regardless of the overall recommendation. For example, consideration for a campus-wide intranet is not necessarily dependent on the complete Working Together action items as part of the broader recommendation on Governance and Strategy. Some work may depend, in part, on effort or change in other areas of campus. For example, better integration of systems may depend on business process changes or clarity regarding their ownership. Providing easier access to data is closely connected to new stewardship and policy approaches and workflows. Changes to classroom support and change must be aligned with classroom and building plans.

The order of these recommendations reflects overall priority, but does not indicate a dependence or preclude action on some specific elements. The format for each area of action proposed by the committee includes a core recommendation, major components and the key considerations or goals for each. While not achieving the threshold for a major recommendation, a number of other considerations are noted at the end of the report.

Recommendations and Considerations

1. Ensure agile and effective decision-making

Recommendation: The university should adopt a well-defined governance, planning and execution model for IT that allows for clear and efficient decision-making, provides necessary direction and a supportive framework that leverages the strengths of local and core IT staff and resources. This will require the development of a new vision, risk framework and 5-year strategic plan for information technology, a streamlined committee structure with the necessary authority and accountabilities and a community approach to IT which promotes working together in a purposeful and coordinated manner.

Governance

- a. Establish a more defined governance structure for IT which enables efficient and responsive decision-making, appropriate oversight, an ability to address issues and concerns and clarifies the roles, responsibilities and relationships for all groups in the IT community.
- b. Provide clarity regarding the senior leadership role for IT and any decision-making role(s) and distributed authority for IT across the University. This includes the nature of the senior appointment (e.g., staff or faculty), focus of the role and accountability for the position.
- c. Make efficient and strategic use of required committees that supports sharing, oversight and decision-making for IT support in the key areas of research, teaching and learning, administrative systems and infrastructure.
- d. Ensure visibility, transparency, responsiveness and prioritize work based on well-defined principles and factors, including user requirements, compliance and best use of resources.
- e. Provide the necessary budget and funding coordination and transparency across units.

- f. Communicate and consult in a manner that reaches the appropriate communities and gathers feedback to support planning and operational needs.
- g. Provide specific direction and clarify accountabilities for technology and systems governance between faculties, IST and ASUs.
- h. Conduct a review of policy(s), statements, guidelines and procedures related to IT.
- i. Ensure that the necessary stakeholder voices are appropriately represented on all governance bodies, with consideration for student, faculty and staff participation.

Working Together

- a. Determine the principles, guidelines and develop a framework which will allow all campus IT units to work together in a purposeful and coordinated way by removing barriers and promoting a culture that focuses on client service, agility, well-understood process and a true, coordinated IT community.
- b. Conduct a more detailed review of organizational services, resources and systems across the institution to provide a comprehensive capability baseline and identify opportunities for efficiencies and enhancements.
- c. Identify specific services that might benefit from a closer affiliation or connected structure, such as help desks.
- d. Build a knowledge management environment and practice, which would include skills, education technology tools, applications, projects or other information.
- e. Create a true campus intranet, which would provide faculty and staff with necessary and secure resources.
- f. Create a framework and opportunity for staff to move more seamlessly between units, whether through additional project or like opportunities and encourage greater use of the existing secondment or temporary assignment structures.
- g. Provide clarity on IT roles relationships and responsibilities (IST/ASU/Faculties/AFIW), by building on defined accountabilities, in order to foster a productive and collaborative environment.
- h. Provide a specific framework for IT staff working together on development activities, which utilizes a process of recognizing need, sharing those and solution approaches, technical environments which might enable transition from local to central where appropriate.
- i. Adopt specific principles, including making best use of limited resources, through reducing redundancy.
- j. Document the understanding for support and any opportunities with AFIW partners.

Strategy and Vision

- a. Develop an overarching vision and a 5-year strategy for information technology, systems and services which will guide investment, priority, technology directions and principles in support of the University's strategic plan, operational robustness and can respond more effectively to business needs and its core mission.
- b. Conduct a review, in alignment with other planning groups and activities, of lessons learned during the pandemic and incorporate these into overall campus plans.
- c. Emphasize and articulate the need for a campus-wide approach which is inclusive of all units and IT staff.
- d. Ensure an emphasis on the end-user as a guiding principle and incorporate service and appropriate consultation as requisite aspects.
- e. Include and drive the development of roadmaps for information systems and other core infrastructure and technology in consultation with all stakeholders.

- f. Define a funding strategy that supports long term planning and investment approaches.
- g. Describe the role of innovation, including the principles and framework for distributed development, management and deployment of systems and technology.
- h. Support needed efficiencies and business process renewal.
- i. Define specific strategies or statements with respect to cloud computing, machine learning and artificial intelligence or other emerging areas where definition, guidance and policy would be beneficial.

Risk

- a. Create of a comprehensive IT risk framework in alignment with the overall University risk management plan, which would articulate practice in areas such as compliance, system lifecycles, audit, external factors and other.
- b. Create a more focused plan for audit activities which will recognize and make recommendations suited to Higher Ed and the UW community.
- c. Address single points of failure through system development and service rollout strategies and robust service management plans.
- d. Enhance existing vendor management practices to more fully monitor vendor performance and plans.
- e. Develop institution wide disaster recovery, business continuity and pandemic plans which coordinate process, resources and infrastructure across all IT providers.
- f. Include a proactive component aimed at addressing pending internal or external risk as the result of new technology, government direction or like factors.

2. Advance learning and research

Recommendation: In alignment with our academic mandates and mission, the institution should provide a more robust and enhanced IT capability to support teaching, learning and research activity. This will involve the creation of a common and core suite of services for researchers, an enhanced framework for the full lifecycle of education technology and additional support for both classroom and remote learning delivery of courses.

Teaching and Learning

- a. Adopt a more strategic approach through the development of an overall plan, strategy and governance, for the educational technology ecosystem. Further, that the campus resource and commit to more consistent, reliable and well-defined funding and support for classroom and education technologies.
- b. Provide improved mechanisms for content and delivery to be shared more efficiently for all modes of course delivery.
- c. Ensure a more robust classroom support model which allows instructors to focus on advancing the teaching practice and not basic services.
- d. Align infrastructure and support for classroom technologies with the new classroom steering and operations committees and overall planning for classroom upgrades and new spaces.
- e. Ensure greater engagement with users and that decisions are made with the student lens and experience in mind, while also ensuring efficiency and effectiveness for instructors.

- f. Review the educational technology ecosystem in order to identify gaps, build a sustainable and well understood and tiered support model, establish a funding protocol and framework and hub for technologies under investigation, being piloted or in a production mode.

Research

- a. Provide a unified, complimentary and coordinated capability of core services that apply across the institution for all faculties and researchers, for storage, software, servers, as well as consulting or advisory services in areas such as data management plans and system or software acquisitions.
- b. Utilize, wherever possible, a 'one-stop approach' for delivery and support for the end-user. This could include a re-imagined web presence for researcher supports and services.
- c. Leverage faculty IT systems and expertise and preserve the local IT and research(er) support relationship
- d. Support a sustainable approach to provisioning research initiatives which acknowledges longer than anticipated lifecycles and the need to maximize initial funding.
- e. Support the needed emphasis and practices regarding security and compliance directives for data management.
- f. Investigate specific areas and mechanisms by which faculty might better participate in IT activity.

3. Enhance support for the campus community

Recommendation: In order to support the increasing complexity of our administrative functions, the university should enhance its position and make specific improvements with respect to administrative systems, data and information, and security. The priority initiatives to achieve this include a multi-year roadmap for administrative information and collaborative systems which addresses integration, cloud considerations, user needs and experience; improved access to and use of data through governance, training, tools and infrastructure; as well as an identification of and strong focus on specific gaps or needs related to security and the protection of data, privacy and intellectual property.

Administrative Systems

- a. Create a purposeful, consultative, and coordinated roadmap for its information systems environment and plan for its evolution over the next 5 years. This initiative should include direction for major systems, departmental or other local applications, an overall architecture, support for important cross-domain processes, continuous improvement support, financial considerations and usability.
- b. Adopt a holistic approach to planning and budgeting across the portfolio in order to better align resources and the impact on the community.
- c. Provide for an increased focus on collecting stakeholder input regarding the user experience and needs.
- d. Improve on the integration needed at the process, data and technical layers.
- e. Emphasize sustainability in the initial proposal stage and execution of implementations and also post go-live priorities, leveraging new platform or system features and the ability to more rapidly adapt to changing process or business need.

- f. Consider specific areas of opportunity, including a more comprehensive portal and new services in content/web management.
- g. Consider the optimal method for selecting and provisioning systems, whether locally developed or externally acquired based on total cost, usability, sustainability, fit to requirements, opportunities for innovation and common versus differentiating services.
- h. Conduct a thorough review of implementation experiences, including benefits realized and any challenges with process and outcome.

Data

Support the work of the Data as a Strategic Resource initiative, for administrative information as framed by the scope of Policy 46, in order to:

- a. Develop a comprehensive institutional data infrastructure including a central data repository ('data lake') populated with data from multiple sources including core administrative systems.
- b. Create a more robust centralized data integration capability, which minimizes the replication of point to point connections and multiple data stores.
- c. Support improved data governance and data management practices by:
 - i. Creating a comprehensive set of definitions and inventory of available data
 - ii. Enabling data literacy, training, and community of practice or related support.
 - iii. Providing an easy mechanism to manage requests for information in alignment with data stewardship and related governance.
 - iv. Developing a systematic approach to identify and address specific data quality issues.

Security

- a. Identify and address gaps and take specific measures in order to better safeguard its intellectual property, data and individual privacy, including clear lines of authority to act on threats when they occur.
- b. Foster an environment where security becomes a key lens and part of the fabric and culture through education, best practices, a community of practice, all of which is geared to the activities and needs of different stakeholders.
- c. Launch specific initiatives which would improve security through support for research and its data, an enhanced asset management system, mandatory training programs, health information, incident response and others to be identified.
- d. Provide the operational capability and ensure that necessary governance and process is in place to quickly deal with issues.
- e. Ensure privacy and security, but support access to data and best practice in that area.

4. External Review

Process

The external review was held from October 28-30, 2019 and conducted by Bo Wandschneider, CIO at the University of Toronto and Sean Reynolds, VP for Information Technology and CIO at Northwestern University. Over the course of those 3 days, the reviewers were able to meet with staff from across campus to hear their concerns, learn where Waterloo had strengths and opportunities to improve. Prior to their arrival, a synopsis of information technology at UW was provided and included basic organization and governance, services offered by various units, the administrative system suite, significant projects or like initiatives, early findings from the internal workshops and other relevant information. In all, they were able to meet with approximately 120 people in 16 individual sessions. The groups were generally peer-based and organized in the following manner:

Leadership	User	Technology
IT Review Steering Committee Deans VP, AP, AVP CIO Provost ASU Department Heads	Students Researchers Instructors Administrators	Associate Deans Computing Faculty IT Directors ASU IT Directors/Managers IST Executive IST Staff

Participants were asked to consider the following questions in advance of their sessions:

- Where do you believe our key information technology strengths are? Where is IT best meeting needs in your area or at the campus level? What aspects would you not want to change?
- What are the most significant gaps or challenges that you see today? Are there important risks that the institution needs to manage moving forward?
- What are your priorities with respect to IT? Do you have any suggestions for more immediate items and others that might require a longer plan or roadmap?
- Do you have any other thoughts on how IT might be improved or serve the campus better?

An initial draft of findings was made available in late December 2019 with the final report delivered to the Steering Committee in January 2020. These recommendations were then considered with proposed actions from internal working groups and individuals during committee deliberations in February and March 2020.

Synopsis

The final external report is contained in the appendices. The reviewers highlighted 5 key and priority recommendations:

1. Moving to a more institutional view of IT
2. Clarifying the role of CIO
3. Better alignment of existing resources for service delivery and staffing
4. Developing a unified strategy for system adoption and development
5. Information security

Recommendations 1 through 4 reflect an overall theme focused on providing clarity regarding roles and responsibilities, a common vision and strategy, and moving both culture and practice to a more unified model. Recommendation 5 relates to a key risk management area, which both benefits from and necessitates the actions in the other recommendations. Though not included in this high-level set, the report also calls for the development of a new campus-wide strategic plan as a formal recommendation.

The report recognized as a notable strength the talent found in Waterloo's IT staff; they are present in all units, whether in the faculties, academic support or central computing group, and the unique skillsets that might be found in each. It also notes a core 'solid infrastructure' and period of renewal in the administrative systems space which has laid the foundation for future improvements. As has been the case with UW as a whole, information technology has seen rapid organic growth, which has led to the need for a better understanding of accountability and where duplications might exist, transparency and coordination in decisions and priorities, more formal processes and overall rigor. The report also addresses an important contextual aspect, that the very structures that support the success of a research-intensive university like Waterloo can at times be an impediment to such changes. The challenge is, therefore, to balance the respective views and culture of the environment. These include the overall university culture which values and respects local decision-making, with the need for better visibility, collaboration and coordination. It will require balancing concerns about agility and speed for large initiatives, with the coinciding need and desire for greater consultation with system users.

Findings and Recommendations

The report considered input and possible actions in the areas described below. Given the approach used for the review, the committee did not respond formally to the individual findings. Rather, they were used to confirm internal feedback or initiate further discovery. These recommendations were then incorporated into the final set of action items from the committee.

Overall, there was general acceptance and agreement with the findings. While the specific actions noted would require some refinement, they are consistent with the committee's major recommendations. A small number would need more careful consideration given the Waterloo context or were viewed as not practical to put forward due to cost or other factors. These included, for example, the specific use of Uniform as an analysis tool for reviewing IT services and staffing. It was also accepted that given the breadth of the review and limitations in time, the report could not reflect all activities, successes or concerns. As an example, there are a number of collaborative efforts such as WatITis not recognized in the descriptions for system and service delivery.

IT Organization

The report describes a general approach where the 'central unit' has responsibility for such areas as strategic oversight for IT and enabling an integrated approach through governance and communications, core infrastructure, systems and security. Local IT would focus on specialized needs and personal support for clients such as researchers and specific discipline expertise or tools. While this does reflect the Waterloo model at a high-level, there remain a number of grey areas and 'philosophical' questions regarding vendors and the place of innovation, as an example. An opportunity may exist to leverage local innovation, but this will require effective governance, ongoing communications and trust. A review of services, any associated risks and future methods of delivery would be beneficial.

Governance

Governance, broadly defined, and the associated aspects of roles and responsibilities, represented one of the most commonly heard pieces of feedback. While serving an important place in alignment, prioritization, standards and coordination of effort, it was noted as being not well understood, absent or lacking. Improvements, in areas such as policy, will need to acknowledge both the need and desire for better practice, and the reluctance and concern that too much structure and oversight will stifle agility, creativity and the ability to 'get things done' when needed. An obvious action would be examining the existing committee structure(s) and their mandates in order to produce a more streamlined model.

Leadership

The focus of this component was specifically related to the overall IT lead and their mandate. While unique in that individuals were not highlighted in other internal or external findings, the role of the CIO as senior IT lead is worthy of mention. Of note, the strength found in current leadership should not preclude or mask the importance and clarity of mandate needed in an overall IT lead for campus; the approach at UW appears to depart from other institutions. This does not imply complete organizational or resource control, but rather partnering with senior leaders and authority for matters such as those related to architecture, strategy, policy, user experience and service, core services and communication.

Communication

As is commonly the case in any arena, communication was described as both a strength and an area of opportunity. Strengths were found in areas such as incident reporting, newsletters, professional development opportunities and projects. Weaknesses were noted in planning and decisions, and of significant importance, in effective consultation with 'endusers' and their feedback. Recommendations focused on continued improvements and exploration of other channels for sharing, communication between committees and like bodies, and better user feedback mechanisms.

Staffing

Frequently noted as a strength, Waterloo was cited for a talented work force with a strong mix of staff with specialized and also broad skills, distributed across the university. Concerns were expressed that hiring was not a coordinated activity for all IT, which might not maximize these often expensive and difficult to recruit resources. A keen desire, included in the recommendations, was that of IT staff mobility across departments and the benefits to campus. Even with local hiring decisions, a more coordinated plan and practice for hiring would benefit the community.

Service and System Delivery

The reviewers focused on the impact of different solutions, multiple providers of similar services and integrating requirements of faculty, staff and students. This was cited as causing confusion in how to get assistance, like systems providing similar functionality and a poor overall user experience. They acknowledged some new approaches, including shared development support in the faculties and a project management capability that was available to other campus units, subject to availability. Areas for improvement included a more integrated service catalogue and campus-wide development framework and understanding.

Funding and Budget

While not a major focus area, the report reflected concerns regarding uncertainties and tensions created by the new budget model, perceived low levels of investment, lack of reliability in funding for major initiatives and overall agility in spending. An important context for the discussion was the current fiscal situation, brought on by changes in government spending. Possible gains could be made through alignment and a systematic review of services and expenditures.

Administrative Systems

Along with the overall theme of governance, the most feedback and suggestions for improvement were received in this area. Frequently cited concerns included the gaps in functionality that exist and methods used to fill these, inequities between different campus areas, sustainability and evolution, appropriate user input, single points of failure, agility and speed of deployment and integration. These systems are recognized as the primary sources of institutional data; access to which was also referenced as a key capability moving forward. Improving this space would require a more holistic, integrated and portfolio approach to their overall roadmap and implementation.

Research Support

Enhanced support for research was noted as an important opportunity. In discussions with researchers, the importance of local IT with specialized knowledge and their direct contact was said to be crucial to their work. There are challenges at times, however, for researchers navigating the overall support network at the university. There is an opportunity for a greater level of service in areas such as data management, storage, other infrastructure and consulting which might be served through a 'common' suite of services, a 'one stop' approach and coordination or placement of central resources. This would also assist in safeguarding information and intellectual property, an area which needs increased awareness and better practice.

Teaching

The findings emphasized the nature of the discussion with instructors, which largely dealt with technical issues or administrative tools and less so on the advancement of technology in teaching practice. These technical issues often centered on classrooms, with start of term challenges, design and faculty involvement, and proactive communication of problems. Challenges with administrative systems included specific technical issues and the overall ecosystem of tools which support exam management, scheduling and assessment. Recommendations focused on the ways in which IT might support the overall classroom and like physical spaces, including an overall plan and vision, and better funded and more flexible and agile support model.

Information Security

In contrast with other sessions, the reviewers noted the general lack of commentary and discussion regarding security. They noted, however, the impact on and relation to reputation, business continuity, finance, loss of IP and overall data integrity. They noted that this is a broad responsibility which will need to deal with ever-increasingly sophisticated attack vectors. Ensuring a comprehensive understanding of systems, information and associated risks, a trained community and a culture of awareness and concern, were recommended.

5. Internal Review

In order to promote discussion, achieve a shared experience and fully uncover issues, the internal review focused on capability themed discussions. It was encouraging to see the active problem-solving, both positive and negative feedback, as well as acknowledgement that others were doing their best even when it might conflict with or not address their needs, as well as genuine respect for other's perspectives and circumstance.

Process

The internal process consisted of the following main approaches and steps:

- General Discovery – This involved the collection and review of a number of documents and relevant sets of information. These included external industry sources such as Educause reports, supported applications, services and service catalogues, recent audit reports, prior IT reviews, surveys, lists and terms of committees, university level documents and plans, such as unit or campus strategic plans, and other resources.
- Theme Workshops – The general format involved providers of services taking part in an initial working session on a particular topic, which was meant to explore current state, identify gaps and possible changes. For scheduling purposes and numbers, these were often conducted in pairs, with a final session of the combined topic group held to discuss recommendations. Topic areas included Data, Research, Support Services, Teaching and Learning, Information System and Infrastructure.
- Group and Other Sessions – These generally were focused on specific user perspectives, including those of students, researchers and instructors. Other sessions included brief presentations to groups such as the Research Leaders Council or Project/Portfolio Community of Practice.
- Interviews – Individual interviews were held with IST Directors, Department Heads, Deans and other senior leaders and staff either by request, to accommodate schedules or other need.

The Steering Committee met at minimum monthly during the year in order to review findings, plan the external review, address specific topic areas such as vision, governance and risk and ultimately make recommendations.

A small number of planned sessions to further validate and elaborate on the proposed directions for security, research support and additional opportunity for student feedback could not be completed due to timing, priority and related circumstances with respect to the COVID-19 situation. While they would have provided additional detail to help frame and support the proposed directions, most include a need or call for additional consultation and analysis; there will be opportunity for future feedback and refinement in those specific areas.

Questions posed to all participants were fundamentally the same – what does the campus do well, where do we need to improve, should this service or function be a differentiator and what areas are priorities for change. Additional questions geared to a group or individual were also explored. For example, those involved in the data workshops were asked to consider the quality,

availability and combinations of commonly needed information. Those involved in the information systems stream were asked whether Waterloo was significantly ahead, behind or simply different than our peers.

Landscape

IT support is provided by a number of primary groups, which include IST, faculty IT Groups and academic support IT units. A specific classification of 'IT staff' is not maintained at the university. For example, some business or data analysts may be found in IT teams within units, but may also report elsewhere. As such, an exact number of IT related resources is subject to some interpretation. Academic support teams range from one individual with IT related responsibilities in smaller units to upwards of 15 in the Registrars' Office. Faculties demonstrate a similar variability, with 4 located in AHS, 12 in MFCF and 20 in CSCF. These faculty figures may not include those IT staff located in specific academic departments, i.e., some larger academic departments such as E&CE or Psychology have their own local staff. IST's current head count is approximately 155 and has decreased from a high of 180 in 2013. Most units have seen a relatively flat profile with small declines or increases in recent years. Some areas such as CSCF, have been able to increase staff count to provide additional support through their research funding arrangements. Distribution lists might have over 250 people campus-wide, with the total number of staff with some significant IT involvement likely in the 300 range.

The actual support method used for various services may follow one of several models or frameworks:

- Sole – While virtually all services include some aspect of shared support, some services are mainly provided by a single unit (e.g., primary and secondary IST datacenters).
- Distributed – IST maintains a number of help desks across campus for core services (e.g., email, wireless). Faculties have their own which are largely dedicated to local services or clients (e.g., printing, academic software). In both cases, staff will assist or direct on other questions as needed. Larger academic support departments may also have a help desk or like capability (e.g., Co-operative Education for specific IT services related to interview schedules or remote workers).
- Divided – Classroom space is generally classified as either central (i.e., administered by the RO) or an individual faculty. Support for these may fall to IST or an academic faculty unit based on ownership.
- Shared – For a specific application or service component, support may be shared amongst individuals or units (e.g., analysis, application development, configuration or standard reporting for PeopleSoft is held between the RO, GSPA and IST).

Note that these categories are not absolute. For example, while both are information systems, support for Unit4 is different than RaisersEdge; groups may support one another and work together in a variety of informal arrangements or understandings. Finances may play a role in this; different sources such as student fees or ancillary department funding can have an influence on role and roadmaps.

At a high-level, IST provides support for most centrally managed IT services on campus which include, for example, networks and core data center infrastructure, telecommunications, administrative application support, security, training, central help desk, learning management, email, central classrooms, web content and portal platforms, desktop rollover programs, PMO

and training. The current software and licensing budget in support of many of these activities is approximately 7 million dollars. Faculty groups provide frontline support for researchers and students, local labs and classroom facilities, specialized software and some administrative applications. IT groups or individuals within academic support units may provide frontline support for the desktop environment, application reporting, system configuration, specific web content, business analysis and project management. Some departments, as is the case with IAP, may have special mandates that historically include a significant IT component. Some research institutes may have their own support, as with QNC or may rely on faculty IT staff. The AFIW community also have local support, though these are typically 1-2 staff and others with part-time support roles.

Previous Reviews

The internal and external reviews conducted in 2003 and 2009, as well as the strategic plan exercise conducted in 2013, held slightly different mandates but all generally contained a scope which spanned IT across campus. Each attempted to answer questions surrounding the university's position and vision, level of investment, roles and responsibilities of units, organizational aspects including the role of senior IT lead and specific issues. The IT Strategic Plan, the first of its kind for campus wide IT, established a common vision and mission, a suite of key objectives and a number of specific initiatives in areas such as cooperative education support, a student portal and mobile accessibility. The plan was ambitious in overall scope, capability, process and principle. While progress in some areas might appear limited, the review did result in a number of important advancements and offers several lessons that have been incorporated into the recommendations presented here.

A review of historic recommendations provided guidance on where the committee might focus its own recommendations. While an exact figure is impossible due to nuances in partially complete work or other rationale, over half of the actions proposed were enacted in some form. These would include such items as a desktop rollover program (DTR), training support (e.g., SEW courses), establishment of governance bodies (e.g., UCIST and CTSC), the consolidation of the Active Directory environment (i.e., Nexus) and usability (e.g., student portal, mobile Quest interface). Some recommendations proceeded in parallel either naturally (e.g., evolution of vendor acquired administrative systems versus local development) or coincidentally with planned efforts (e.g., implementation of Waterloo Works to improve the coop student experience). A few were not enacted or less successful, including such items as the rebranding of IST, redefining and positioning of the senior IT lead or building a global knowledgebase for expertise and best practice. Others are more difficult to quantify, as is the case for consideration of staff movement between units, where the recommendation was less specific or more promotional in nature.

While an imperfect characterization, the less successful recommendations reveal common elements, whether through their presence in feedback today or lack of enactment. Establishing common request tracking software, an overall prioritization scheme, more seamless help desk experience, onboarding, specific investment and budget changes have all been addressed to a lesser degree. All of these would require certain elements to be successful, including a direct focus on user experience, a more 'combined' IT community and clarity in mandate and role. That these elements appear in the reviews as notable action items and ones that have persisted, is a strong indicator that they need to be addressed.

Analysis

Strengths, weaknesses and opportunities for specific capabilities and services are described in more detail in the sections on those topics. A number of overall themes, however, were present in many discussions.

Frequently cited as a strength, the campus has significant depth in human IT resources. This is reflected in individual skills, sincere interest in providing excellent service and dedication to the university itself. Large projects have often been successfully completed with less consulting support or overall expense than experienced by peer institutions due to this strength and the ongoing approach to self-sufficiency and self-reliance. These same resources have demonstrated improvements over the past number of years in a general willingness to work together and the importance in that collaboration. Similar sentiments can be found in communications, where improvements in notifications, changes to services, promotion of service offerings, newsletters, within projects and with stakeholders overall. The group that supports teaching and learning activity, which includes CTE, CEL, Library and IST, is one of the longest standing such communities.

Technically, while there may be point problems, such as specific WIFI zones, the overall network, server and related infrastructure environments have been described as robust. Important investments have been made in redundant data centers, network connections to the outside world and elsewhere. As well, while there may be concerns with workflows, functional gaps, workload changes, integration and overall usability with respect to administrative systems, there is recognition of the significant work completed in a relatively few short years. A number of major upgrades or new systems have been implemented for HR, Finance, Coop, Library and SSC with others now underway for Wellness, the WCMS and Office of Research; all of which have contributed greatly to overcoming an information systems 'debt'.

Awareness has also been demonstrated for key needs and changes in the industry overall, with the establishment of the DSR Program for data and information needs or use of SaaS services where appropriate, to more rapidly leverage more commodity-based services such as email and in building a focused group for security within IST. Faculty IT units have also responded to change, adding support for new visualization software in teaching, support for remote thesis defense, local administrative tools, mobile computing labs, admissions assessment tools and other areas where unique needs have presented.

Participants were able to identify, with considerable detail and clarity, the challenges they experienced, many of which are consistent throughout the discussions. Natural areas of tension do exist, where needs, wants or plans may be in conflict. Reporting and planning requirements for data in faculties may be in conflict with HR related legislation or policy. Innovation is a key brand element for Waterloo, but may stand in opposition to efficiencies in standardized or centrally supported solutions. Industry trends and market realities associated with the move to cloud-based solutions and associated benefits may meet concerns related to costs, privacy and other apprehension. Concerns regarding agility and quickly meeting needs for new functionality may appear in contrast with the need for more extensive consultation and overall change management. A desire for a common classroom experience may stand in opposition to individual instructors' creativity and experimentation with new tools. Local versus global optimization and its balance has been frequently cited as a challenge. While IT providers individually attempt to navigate these with best intent, there may not be a good framework to resolve these inherent conflicts. Finding balance in these represents one of the more challenging and often time-consuming tasks for staff. Other consistently identified areas for attention included:

- Resources – Staffing levels were frequently characterized as “just short of acceptable”. Reasonable objectives for some services do exist, as is the case for creation of SharePoint sites, creation of virtual machines, acknowledgement of basic RT submissions, responses for research support or classroom troubleshooting. These are based on a combination of existing resources, aspirational service levels, community priority and demands, technical need and other; there is though no single service delivery promise or overarching set of principles for all areas. Despite those uncertainties, units typically noted a shortage of one or two resources. The ability for staff to move between various areas and allow for more of a shared approach was offered as a partial solution to overcome some of the peaks in workload.
- Business Process – Integration of administrative systems, especially where a best of breed approach has been prevalent, could improve both technical integrations and business process changes. Technology can support processes that span multiple campus units, as in the case of graduate student onboarding, but this requires strong support as well from academic and academic support units and leadership.
- Knowledge Management – Many expressed a greater desire to share information, and have greater visibility into IT activities, including skills that might be accessed, projects underway, application inventories and other. This is consistent with the recent Excellence Canada Going for Gold effort, where the need for a common ‘intranet’ was strongly expressed.
- Agility – Participants noted that, in general, projects and initiatives take too long to launch and complete. Multiple reasons were given, including more extensive compliance (e.g., procurement legislation, privacy review), extended consultations, difficulty in obtaining agreement and necessary decisions, budget uncertainty or unavailability and resourcing. CRM systems provide a useful example, where there have been several unsuccessful attempts over many years to launch an initiative. The difficulty in gaining agreement on sharing data and like rules can prove more difficult than the actual technology.
- Sustainability – The systems implementation record has been solid; with rare notable exceptions, there have been few fully canceled efforts or failed initiatives. However, concerns were expressed about the ongoing effort to maintain systems and leverage the capabilities and investment made. Locally developed solutions might, in some cases have been completed by a coop student, with no longer term plan for their evolution. Research efforts may not anticipate long term operation of equipment due to the lack of funding for maintenance or upgrades.
- Complexity – There are cases where multiple solutions appear to exist for effectively similar functionality, as is the case with booking or scheduling systems and applications for video streaming and capture. Certain campus functions, some of which would be considered relatively basic, are supported by multiple units and applications as is the case with exam management which involves over 10 applications and multiple supporting campus units. Balancing this complexity requires consideration for local versus broader needs and the ability to compromise, vendor product strengths and gaps, an architectural approach as well as the time, opportunity and priority to unravel historical situations.
- Environmental Factors – External and internal pressures have impacted IT direction and operational support. Changes stemming from the Ontario government have highlighted the need for agility in dealing with issues such as opt-out tuition fees. Funding announcements at

the provincial level in 2019 placed increased pressure on software spending, contract positions and the overall IT budget; these will need to be assessed further as the full impact of the current 2020 situation is better known.

- Governance and Planning – With few exceptions, governance, or some aspect of it, was the most frequently cited area requiring change. This included concerns with the overall number of committees, their role in decision making and its process, connections between them and visibility of activity. Closely related were principles, including the approach to prioritization, or lack of an overall portfolio approach to projects, architecture and services. The ability to plan and develop roadmaps also had concerns noted, whether for longer or larger infrastructure efforts, coordination of information system activities and other.
- Decentralized Model – There is general agreement that certain services and applications are best provided locally where others are more efficient if managed centrally, in keeping with the 2003 Review and our historical approach. Difficulties arise in the less obvious ‘grey’ areas or where priorities and expectations don’t align. In these cases, considerable resource is consumed in discussion, support and complexity and has the most opportunity for improvement.
- Data – Challenges noted for the university were similar to those faced by industry in general. Greater rigor will be required for research data, as work is underway and for archival purposes, with the advent of newly mandated data management plan requirements. There is a greater need for readily available information of high quality to help make informed decisions and support planning efforts. The ability to know what data or reporting is available, the lack of common definitions and quality were some of the areas for improvement.
- User Experience – Thoughts regarding user experience encompassed everything from actual UI design through system support for business processes that users must navigate. A common theme expressed was the need for a deeper understanding of user needs and the process by which this knowledge can be gained, in particular where faculties were concerned. Participants were not advocating the elimination of a ‘90/10’ approach, but rather promoting a full understanding of what people need for their work and using that to guide priorities for efforts.
- Expectation Management – Waterloo’s brand speaks strongly to innovation and its excellence in the STEM disciplines. As a result, expectations from new campus members are very high. There was general agreement that we are not meeting those expectations and that there is a disconnect between what might be desired and what is practical. Users also have high expectations based on their experiences in commercial or social offerings or work in private industry, which may not be possible to meet at a public institution.
- Risk and Audits – Over the past 5 years, the university IT space has undertaken a number of internal audits, conducted by Deloitte and reported ultimately through the Audit and Risk Committee of the Board. These include exercises in each of the faculties, as well as for project management, disaster recovery, cyber incident response, identity management, cloud computing and email. While there were specific recommendations for each of these, an overall theme does emerge and can broadly be described as a need for the adoption of common industry frameworks such as COBIT or more formality in process (e.g., release management) and additional documentation to support these. In general, the response to these has been

that the university adopts a 'right-sizing' approach, which balances risk mitigation with additional effort and has made continued incremental improvements in these areas as a result.

- Trends – Costs related to ongoing maintenance and support for various services have increased at a substantial rate. A number of factors have contributed, including the shift to a SaaS model, increased student enrolment or employee counts on which some licensing is based, vendor increases beyond inflation, currency exchange as many contracts are billed in U.S. dollars and other. The dominance and opportunity of cloud solutions represents a paradigm shift in costs (e.g., larger initial acquisition costs versus higher yearly spend), staff skills (e.g., a shift to business analysis from development), overall resources (e.g., expectations of savings versus the reality of working in the cloud), different work required for integrations, access to information and diagnostic tools, vendor management which might involve performance monitoring and more frequent upgrade cycles. Almost half of the departmental based applications supported by DCA in IST are now in the cloud, with another 14 projected in 2021; 10 on-premise solutions will be retired. The university has, to date, adopted a 'best solution' model in selecting cloud versus on-premise solutions; it has not generally moved to PaaS offerings, with some exceptions for recent work in Azure for the data program or Pantheon for our Drupal/WCMS environment, for example.

IT efforts should be closely aligned with the strategic plans of the university. The committee considered the high-level statements, objectives and promises contained in the new 2020-2025 'Connecting Imagination with Impact' plan and identified areas where work could support its goals. At this time, the accountability framework is in progress, along with the planning for specific initiatives. As a result, alignment with the plan is in broad terms and reflected in elements of this report's recommendations. The focus on climate, for example, can be supported through partnership with campus sustainability efforts, the design of server rooms and spaces, procurement practices and minimizing paper-based processes. IT might support the advancement of research for global impact through enhanced interdisciplinary collaborative and information sharing platforms and like infrastructure. Administrative practice could be supported through more integrated and comprehensive solutions for coop and experiential learning, or tools that would enable students, faculties, RO and GSPA to better manage flexible learning pathways. Developing our talent could take a number of forms, including opportunities for IT staff to work in other areas or additional training supports for the campus as a whole and learning integrated work.

Private sector trends and those involving the broader higher education community can have an effect on IT needs and plans for the campus. In some instances, these impacts are more preparatory and require investigation or longer-term planning. Others call for more immediate action as might be the case with specific directives or changes from MCU and provincial government. Some trends are largely confined to areas of research for students and faculty, as is the case with autonomous vehicles. Economic concerns with the increase in automation are less felt in higher education, though there are skills and other workforce considerations. Potential impacts for higher education specifically can be found in the 'EdTech' space with virtual or augmented reality (e.g., Virtual Trail, Virtual Environments and Virtual Human projects or software) and gamification. There are a number of areas that have had, or soon will, a presence in both research and administrative realms. Blockchain technology has active research on campus and may soon play a role in micro-credential efforts for WatPD or in document validation which could aid admissions and the reduction of falsified credentials. 5G technology, artificial intelligence and associated learning are all research areas with potential use for administrative purpose in the not too distant future. Predictive analytics, in areas like student success, may rely heavily on machine learning. The recommendation regarding research support speaks to the

potential to leverage campus expertise in these areas as they move to actual use. Other common IT trends have a more direct and immediate impact, including the move to cloud-based services, chatbots, multi-factor authentication and other cybersecurity enhancements.

Finally, the committee also considered the question of vision and mission. The IT Strategic Plan developed in 2013 established the following for these:

- IT Community Mission: Enable an exceptional, innovative, IT environment through engagement, creativity, and impact.
- IT Vision: Enable the University's mission through exceptional learning, teaching and research environments.

These are consistent with a review of like statements found throughout higher education. These frequently cited the need to support all communities (i.e., teaching, learning, research and administration), alignment to overall planning, efficient and quality service, and also principles related to excellence, collaboration or integrity. A smaller number described positioning as bold or innovative and captured aspects related to investment. The Steering Committee, in recommending a review of vision, mission and principles, believes that while these provide some notional guidance, our community would benefit from a more concrete set of statements and objectives. They should address questions such as whether information technology is a differentiator for campus. Opinion throughout the review diverged on this matter, with many suggesting a position that focused on robust and reliable services, though others advocated for a presence more in keeping with the reputation for innovation. In some instances, a balance was preferred, with the primary focus on key core and local services, with a strategic view to select opportunities to demonstrate innovation. Traditionally, administrative IT has taken a fairly conservative approach to the adoption of new technology, as was the case in providing mobile interfaces. The factors involved include meeting expectations for reliable services and support, aspects related to overall cost curves and a culture that did not appreciate failed projects. The more rapid pace of change with technology requires a different set of guidelines moving forward. Fundamental questions with respect to richness, independence, local optimization and innovation versus efficiency, simplicity and global optimization remain for further study.

Throughout the discovery process, there was a large degree of consistency in the feedback received. As an example, individual groups of students had very similar lists with respect to what was good about IT services and what might be improved. These were not, in fact, dissimilar to input received in the IST 2017-2020 Strategic Plan process. Printing was considered a general overall strength. Administrative applications, such as Quest, were noted as being dated, or basic and lacking in some specific functionality, but generally doing what was needed. Concerns noted with other systems, such as Waterloo Works, were often actually related to business process and regulation. WIFI coverage and performance in some areas was the most frequently noted concern. Unnecessary duplication in tools and associated costs with educational technologies such as clickers, along with the condition of classrooms and technical support could also be improved. Students also mentioned a lack of awareness of what help was available and where to find it; this was noted as a shared responsibility.

Waterloo is not unique in the majority of these findings, though there might be a greater degree or emphasis in some. Simon Fraser, for example, has adopted a 'One IS' model, with the foundational elements of unified research computing, a teaching and learning ecosystem and integrated administration processes. Others have recently embarked on data initiatives, such as that at Toronto. Waterloo is no stranger to collaboration with its peers, as demonstrated with TUG and the Trellis system; this has now broadened to a partnership with a dozen other Ontario

institutions and Alma/Primo systems as part of the OCUL Collaborative Futures series of initiatives. Special interest groups have recently formed within CUCCIO for data, applications and project/portfolio management, complementing those already in place for teaching and security. These reflect the growing need for attention in these areas. Security provides examples of both priority and collaboration with our peers as well, where Waterloo participates in the global Research and Education Networks Information Sharing and Analysis Center.

6. Theme Summaries

Data

Scope

In framing the discussions around data and information needs across campus, there was healthy discourse regarding the role of technology and technical support as compared with the overall practices related to analytics and policies which might go beyond IT. While the committee focused primarily on the direct impact and takeaways for IT in its deliberations and recommendations, the workshops themselves considered a broad range of capabilities related to data, as a full understanding of the overall space was considered important in determining technology's role and positioning on campus.

Workshops included staff from across campus, both users and providers of information with many possessing both roles. Participants included those from the Library, Office of Research, Secretariat, IAP, IST, faculty representatives at both a technical and administrative level, key functional areas who use or provide core information such as HR, Registrars, Finance and other. The scope for discussions covered areas such as:

- Operational (e.g., needs related to admissions progress and process, coop interviews, residence acceptances, retail and food inventory management, academic advising)
- Analysis (e.g., academic accreditation and program reviews, library collection management, benefits usage, investment monitoring, help desk utilization)
- Planning (e.g., strategic enrolment management, workforce planning, budget, projects, capital spends)
- Reporting (e.g., Senate and Board packages, UW Strategic Plan updates, COU Space report, count date claim)
- Sources and Supports (e.g., IAP, IST, faculty IT, Departmental, Data Analysts, external datasets such as those from StatsCan, core administrative applications such as Unit4 or Waterloo Works), 'warehouses' which might include basic spreadsheets, OAT, historical Quest count date copies)

Data collected in the conduct of research activity was not a part of the discussion, though some support aspects were considered as part of general capabilities for data management or storage; these were further explored in the research workshops.

Questions

In addition to the general high-level questions posed of all groups, the data workshops considered some of the following specific questions:

- What are the most commonly used or valuable sources of information in your work?
- What data do you need or want to consume but can't? Are there important combinations of data that are currently unavailable?
- Are there sufficient resources in terms of understanding, skills and quantity to make use of the data available?
- What are the challenges in your area(s) in providing information to the campus?
- Where is the quality of information a significant obstacle?
- What opportunities exist to become a 'data-driven' organization?

Highlights and Recommendations

The priority action areas identified included:

- Governance (e.g., clarifying roles, accountabilities and responsibilities, principles, and better support for stewards and users of data)
- Literacy (e.g., a comprehensive glossary and definitions for data, support for the use of tools and their availability, improving the interpretation of and business insight into data)
- Solving Problems (e.g., increased support for the DSR program, help with immediate needs, support for combinations of data)

Other high priority items included establishing a campus community of practice for data and analysts which could assist with sharing knowledge and improving communications at all levels. This might also include a 'data lab', with expert knowledge in tools, data stores and practice. Addressing specific pain points with respect to the quality of information, such as course instructors or room and location information, was highlighted. As well, better technical options are needed to enable integration in some cases, in particular with the advent of more SaaS solutions. These are often related to vendor shortcomings.

Observations

Definitions for the most commonly required data elements, the ability to know what is available, understanding the sourcing and lineage of data and a well understood framework for access and the promotion of data use were the most commonly cited needs moving forward. Understanding that there may be multiple use cases or variations of similar information is important, as is the case with 'current student', which might be different for official reporting versus internal planning needs. Removing barriers to access information will require a combination of new guiding principles, simpler workflow for requests and changes to governance and policy. Basic combinations of information, such as 'companies' which might have a relationship with campus as coop employers, corporate donors, suppliers of goods and services or research partners, are not readily available. The conversations reflected good intentions and a great deal of dialogue across campus, but that concerns with interpretation, privacy, roles and complexity in this space often created tensions.

There was overall agreement on a number of aspects, including the recognition that the university has a wealth of different types of data at its disposal due to its diverse set of operations. Some contrasts were noted, including the desire for open access, with the need for security and risks with appropriate interpretation and use. With respect to maturity, our data practice is one of large need and growth with resources being added in the form of local data analysts and skills in general; training will remain a strong need as there is a great deal of variability in expertise.

Strengths were noted in a number of areas. Core areas show an important duty of care, which include practices related to security and privacy; requests and access to information through administrative applications are generally well understood and managed. Data is well-managed at the department level and in areas such as archival, storage, and backup to ensure business continuity. There is a greater overall willingness to share data in order to help the community guide decision-making. Policy 46 has been instrumental in providing a strong initial guide for stewards and those that need access. There are improved capabilities and resources, such as the DIA team in IST and the Azure environment now in place. The DSR program validates the importance of data and information and builds on important earlier work that has identified needs

on campus, such as OAT and its associated data store. The previous and new university strategic plan use data to communicate a consistent story and measure progress for major themes of work. Reporting, access to data and analytics requirements are clearly identified in RFPs and implementations

There is, however, a long way to go in building a robust data practice and capability. Integrating different sources is a challenge; reporting that combines multiple areas is difficult as are the mechanics sometimes required to do so. Examples included 'plan level' information, domestic and international enrolments, student outcomes and that required for budgeting exercises. Reporting on information at the right level, from individual to aggregate is also challenging depending on circumstance. Answers to 'quick' questions for planning involving even basic information can also be difficult. Analytics as a practice will need continued support in the form of definitions, tools and even advanced techniques that involve more 'predictive' exercises. Some noted that the use of external resources to do analytics work, such as that with the Accenture activities for student mood or women in STEM, could be done on campus. The ability to execute on requests, even approved, is sometimes hampered by priority or other factors. The consistent presentation and interpretation of data is important, but can stand in opposition to different 'working' or 'temporary' needs. Some noted that there is a fundamental difference between data and information. Understanding the risks involved in different scenarios is important and often requires a conversation over the problem people might be attempting to solve. Concerns were also expressed for where data might end up downstream and used for a different purpose than in an original request. Important questions remain as well over which groups have responsibility for reporting what information and when.

Participants noted other specific concerns. While there are a number of external datasets of value to the campus, budget has not been available to acquire a number of these. The loss of reporting with the implementation of some large systems, such as Unit4, was noted. Data for continuous improvement work often involved using KPIs based on what was available as opposed to what was needed. Other gaps or quality issues included, for example, more reliable and timely space information, for OUAC versus out-of-province students and a need for 'point in time' reporting, both historic and current, as opposed to scheduled or cyclic datasets. A number of opportunities were noted in greater sharing which would promote a better user experience, such as the SSO and availability of awards.

Infrastructure

Scope

Information technology infrastructure is generally defined as the set of components that serve as the foundation of IT services. These typically include physical components such as computers and networking, their facilities and any related software. For the purposes of the review, discussions covered these main components and related services, including:

- Networks and Cabling (e.g., design, end points, external connections, VPN)
- Servers (e.g., virtual machine infrastructure, faculties and IST, OS management)
- WIFI (e.g., physical access points)
- Datacenter (e.g., central MC and EC2, local faculty)
- Storage (e.g., Netapps, information system specific arrays)
- Infrastructure Applications (e.g., asset management, SCCM, GIT)
- Disaster Recovery / Continuity (e.g., failover testing, alternate power generation)
- Data and Database (e.g., SQL, Oracle, Postgres)
- Workstation (e.g., desktop rollover program, encryption)
- Physical Security (e.g., motion cameras, doors)
- Printing (e.g., student, departmental, retail)
- Other (e.g., specialized equipment, PaaS considerations)

Participants were drawn primarily from CTSC or delegates, which includes representation from each faculty, Library, IST and WUSA.

Questions

- Are roles and responsibilities clear between various units (faculty, academic departments, ASUs)?
- Are there specific investments or initiatives, in people or technology, that should or must be made and for what planning horizon?
- Do the licensing models used, budget processes or 'who pays' present any challenges in supporting IT infrastructure?
- What are the gaps in services of most concern?
- Are there external pressures or changes on the horizon that should be considered in the next few years?

Highlights and Recommendations

While many of the details cover infrastructure specific aspects, the main action themes were similar to those indicated in other areas and include:

- Establish a unified research support group and suite of services that can deliver core technology and related support. An emphasis might be on transdisciplinary and interdisciplinary efforts.
- Ensure that decisions regarding equipment and other infrastructure consider sustainability and have environmental impact in mind. This also mandates a more consistent and fuller lifecycle view to acquisitions, deployment and decommissioning.
- Creation of a common faculty data center for core or common academic needs, with appropriate incentives or disincentives.

- Creation of a comprehensive strategy for campus technology, specifically as it relates to infrastructure. This would include buy or build advice and guidelines, cloud versus on-premise considerations, defining what our core services are and identifying differentiators which would help guide local effort and commodity acquisitions.
- Improved onboarding, provisioning and deprovisioning of staff; this would help local IT focus more on unique needs and also improve security. This includes elements of training on systems, greater use of roles-based authorization, more automation for common startup needs and other.

Other detailed items included the need for better connections with Plant Operations for the management of outages, power and its costs and other physical considerations. Some pressing needs were noted regarding VLAN flexibility and for individual server rooms. The pandemic has also demonstrated the potential for most staff to part with the traditional deskset and move to a soft phone approach. This is consistent with general trends in business and the community and is an opportunity to simplify the telephony space and reduce costs. It has also highlighted the need to focus on the virtual delivery of applications, with less reliance on technologies such as RDP. This will have licensing implications for products such as Adobe Creative Cloud for students and in the provisioning of physical lab spaces.

There was general consensus that campus infrastructure was robust. The creation of failover datacenters, including backup power generation as part of a solid disaster recovery capability, is one example. This was tested in summer 2018 with the extended power upgrade in MC. There are, however specific needs for improvement in areas such as wireless, where increased classroom, library and lab usage has strained capacity; a project to address this is now underway. Recent improvements were noted when it came to working together, in such areas as feedback, service transitions and ticket management overall. However, it was also noted that much more could be done in all of these.

Agreement in the quality of delivery was found for many services, as was the case for student printing. There were a number of interesting contrasts or differences noted, however. While the overall infrastructure is sound, there is a sense that a 'debt' may be growing and large investments are on the horizon, as is currently being made for wireless. Our people and 'break/fix' ability for immediate problems was considered a strength, but the ability to develop longer-term plans might be lacking at times. A notable challenge came in providers balancing the need for all to have the essentials and equal treatment, against the higher demands that naturally occur in some areas.

Observations

The group highlighted several examples of our strengths, which included security operations, central services related to email and exchange, print services, desktop management, internet connectivity and reliability, Eduroam and shared storage. The strong combination of fast local support alongside enterprise wide services and creative problem-solving speak to the human side. Core support for classroom podiums by individual units was described as strong, though the differences between the units raised concerns with instructors. Benefits were noted when people had the opportunity to move over time between faculties, IST and ASUs.

In addition to the areas described in the recommendations, the group touched on a number of areas of concern or possible improvements. These included support for Mac, Linux or other desktop environments, better licensing practices for software, the handoff of requests between different service providers, support for open data initiatives, external collaboration tools and more self-service options. Concerns were expressed around 'donations' of goods and services which

were not always aligned with priority and need and have proven difficult to support. Discussions also touched on needs for researchers in areas such as data management and their potential involvement as a resource in various projects. In addition to the pending need for major investments, concerns with existing budget practices were described. Aspects to this included the immediate ability to react due to delays in confirming funding for both operational and project work, year to year uncertainties and within faculties specifically, different tiers or levels of support. Smaller but sometimes heavily used platforms such as GIT could benefit from more consistent resourcing.

Other concerns included those related to working together, guiding principles or other governance. It was unclear what the exact arrangements were with the Affiliated Colleges; staff often assisted or consulted, though the actual mandate was not well understood. Further discussion was suggested to determine the appropriate levels of service for some functions, i.e., when did something need to be robust or redundant and how would that be defined or achieved (e.g., specific network demands), or where could greater risks be taken and allow for some experimentation or innovation. Dealing with rogue access points was one example where different areas worked well together; however, there were also concerns where even with guidelines or agreements established, they were sometimes not treated as binding. Succession planning is also a concern in some areas, a number will experience high turnover in the coming few years.

Teaching and Learning

Scope

There are many definitions used to describe educational technologies, frequently referred to as 'EdTech', though generally this space is considered to include physical hardware, software, and practice to facilitate learning. From a Waterloo perspective, the workshops included discussion on the following topics and related capabilities:

- Organization Specific Resources and Supports (e.g., Library)
- Classrooms (e.g., podiums)
- Technologies (e.g., Tophat, MATLAB, visualization)
- Administrative Systems (e.g., Quest, Akindi, Odyssey)
- Learning Management (e.g., Brightspace, Mobius)

Workshops included participants from supporting units such as CTE, CEL, IST, Library and faculties, as well as instructors. A particular challenge in deliberations and discussion came with respect to classroom spaces. The experience for students and instructors here is framed by a combination of information technology, general physical maintenance, scheduling issues and basic technical characteristics; separating these components for the purpose of the review was necessary, but it is also important to recognize the interplay and connections found between these elements.

Questions

- Where do you believe our key information technology strengths are with respect to teaching and learning? Where is IT best meeting needs in your area or at the campus level? What aspects would you not want to change?
- What are the most significant gaps or challenges that you see today? Are there important risks that the institution needs to manage moving forward?
- What are your priorities with respect to IT? Do you have any suggestions for more immediate items and others that might require a longer plan or roadmap?
- How do we compare with our peers?
- If there was one thing you could change with respect to instructional supports, what would that be?

Highlights and Recommendations

The priority considerations raised were consistent across workshops focused on providers, instructors and also within the external sessions, and included:

- Ensure that EdTech is recognized by senior leaders and that the financial and human supports are in alignment with the goals and objectives for this space.
- Develop a funding model that is more predictable, structured and managed, with some increased support for common or central services.
- Create a more open and better understood process for investigating, procuring, implementing and culling specific educational technologies.
- Ensure that human resources are available in a fair and balanced manner across campus and are able to support EdTech through its full lifecycle.

- Develop a more systematic and consistent practice for obtaining instructor and student feedback and ensure that those who are closest are involved in decision-making.
- Provide a more robust and problem-free experience within the classroom.

Many of these recommendations are reflected in a draft proposal for meeting the educational technology challenge; this is currently with senior leadership for consideration. That proposal includes significant changes related to transparency, sharing, inclusivity in decision-making, more cohesive and comprehensive support, along with a more structured approach to governance and an appropriate funding framework. As with other areas, there are obvious 'tensions' in EdTech. Many noted that this is one area in particular where agility is important, but at the same time there were a number of concerns regarding duplication of like tools. Some advocated for a more consistent classroom layout, while others noted this would be difficult to achieve or reach agreement on a standard. A notable sentiment was that IT supports were sometimes perceived as being less than offered for research, despite being a core mission of the campus; this difference was seen to reflect a general situation at the university.

Without question, concerns regarding classrooms drew the most comment and concern, with less time devoted to matters involving the possible uses of technology to support new ways of teaching and learning practice. Matters related to the design of classrooms also received a lot of attention, including the consultation process for new or upgraded spaces, the legacy impact of physical construction on what can be done and the impact of decisions regarding aesthetics versus functionality. Simple items, such as the practice of locking podiums and process to gain access were cumbersome; a recommendation was to allow for locking but provide broad access across campus to most instructors. Discussions regarding technical design and support for classroom evolution will be an important consideration for the newly (re)formed classroom space steering and working committees. Lab spaces also received comment, in terms of overall quantity, ability to schedule and share, as well as the differences between faculties. There were varying levels of awareness of tools available, or the capabilities of individual tools depending on the experience or interest of individual instructors; this is an opportunity for greater training, outreach and general sharing of expertise. Students generally spoke to the need for fewer tools serving the same function and overall, as well as concern regarding additional costs that might be incurred in the use of some of these. Administrative systems, such as Crowdmark, Akindi and Evaluate, drew comment regarding specific technical challenges in terms of being able to identify students, inconsistent logins and also broader issues related to duplication in areas such as assessments.

Observations

Waterloo was described as having a diverse and broad ecosystem for teaching and learning, with good collaboration and community, though this was also described as feeling more like the 'wild west' at times. There is a sound level of expertise in educational technologies. Incident response is often excellent, though physical distances are making that more of a challenge. Specific services such as Eduroam were praised, though WIFI itself could not meet expectations, in part due to unforeseen use cases, such as 'internet of things' teaching labs.

Agreement was consistent in a number of areas, in particular the need to focus on basic services and attention there. The use of coop students on help desks was not considered ideal in handling some more complex questions, in particular during their ramp-up period at the beginning of term. Contrasts included the existing freedom that departments have to support important differences, as with the Stratford campus, with the need for greater consistency and governance. The current LMS, Brightspace, was noted by some as working well and enabling instructors to be self-sufficient, but also lacking in some functionality, such as that needed for progression through a

course or set of learning outcomes. From a maturity perspective, there is good teamwork across units, but the existing approach and structure is not well-equipped to deal with an increasingly complex space with more online, remote and multiple mode delivery needs. Concerns were expressed that there had been an inability to plan for or take advantage of some opportunities. There is a lot of variation in licensing models for some software, such as Maple, which might see a single unit as the primary user and licensee sharing with others, to more central purchases, to individual use cases. Renovations to MC2009 to support a joint UW and Toronto initiative was an example of immediate need that could not be fulfilled; from a longer-term view, little is yet known regarding the potential impact or opportunity of 5G networks.

Weaknesses also included difficulties in re-using content between fully online courses developed in CEL and other modes of delivery, technology to support active learning and more flexible 'pop up' spaces, challenges with the O365 multi-tenant deployment and file sharing there, managing class rosters, guest wireless accounts, aging projector technology in some rooms, notification processes for 'out of service' rooms and other. Concerns regarding a variety of scheduling practices were also associated with Infosilem itself, though aspects related to, for example, travel between buildings were more process and practice issues than technology.

As part of the overall need to enhance the online experience in the future, there will likely be greater demand for online delivery and associated services. This would include capabilities such as lecture capture, which will have implications for classroom equipment and other supports. The university has been noted for its promotion of asynchronous delivery and its role in equity as part of its approach to the pandemic.

Research

Scope

Advancing research, in several forms, is reflected in the 2020-2025 UW Strategic Plan as one of the signature commitments and as one of the impact themes. The plan also emphasizes, in its goals, aspects such as those related to interdisciplinary work and leveraging partnerships. IT will be a necessary enabler to achieve some of the specific objectives. The outcomes of the research workshops reflect those themes, i.e., the partnerships and interdepartmental or interdisciplinary work that could provide improved research support. Participants in the research workshops included those who work directly with research activity within faculties, Office of Research, Library and IST. Discussions covered a range of topics, including but not limited to technology support in the areas of:

- Data Management (e.g., plans, compliance, storage)
- Digital and Research Scholarship (e.g., library resources, bibliometrics, profiles)
- Collaborative Spaces (e.g., conferencing, file sharing)
- Administrative (e.g., reporting, ethics, grants)
- Specialized (e.g., networks, high-performance computing, IOT)
- Core Services (e.g., desktop, help desk)
- Government and External (e.g., CANARIE, Compute Canada)

An interesting observation related to support staff in faculty computing groups who provide what might not be considered traditional IT. Specialized sensing devices or gas chromatographs in labs are occasionally supported by both technical and IT staff. Some very recent activity within CANARIE (e.g., the new DRI initiative) was discussed and may create opportunities, but will require further investigation.

Questions

- Is there a common definition or understanding of what comprises effective research support or is required by researchers?
- What are the more common problems or gaps cited by researchers themselves?
- Are there special considerations which need to be taken into account in any future design (e.g., role of research assistants, nature of institutes, high performance computing)?
- Are there significant differences or inequities between faculties or groups in general?
- Is there a baseline of services that can be delivered in a common manner?
- Which new compliance, major initiatives, UW Strategic Plan directions need to be taken into account?
- Do we have sufficient or effective IT support for related administrative processes (e.g., financial or related reporting, profiles)?
- What are the impediments to researcher collaboration, both in and outside UW?
- What are the challenges posed by external agencies, their governance and services (federally, provincially, etc.)?
- What is the impact of the model(s) for research funding on IT and are there ways UW might provide better support?
- Is there a known model or best practices at any of our peers worth considering (all or a portion of)?

Highlights and Recommendations

Priority action areas identified by the group included:

- Establishing a 'unified' data center with support for common storage, software or processing needs.
- Creating a center of excellence, community of practice and unified knowledge and service hub to support local IT and provide core services for the full lifecycle of research activity.
- Re-imagining the research 'web experience' to promote the various aids and help available and combine services offered by various departments in one portal or like space.
- Promoting a collaborative structure and promise across faculties, with equivalent access to services and/or funding
- Building a more complete and robust data management capability, which would help researchers deal with compliance, both active and archival data, 'big data', high-speed data exchange and other services.

The group noted a number of other important considerations and action items, such as the need to reduce the administrative burden on researchers wherever possible; this might include a shared pool of resources, whether within a faculty, across faculties or administrative units, that might help with purely administrative functions. The need to keep costs for local services competitive with 'consumer' options is needed to minimize the risk, for example, of information being stored in less secure environments. As with other streams, the group advocated for a knowledge management capability, by establishing and documenting best practices for research procurement and other functions. Feedback was sometimes very detailed and specific, which speaks to the individual needs and unique characteristics of research projects. For example, specific power level and quality issues were raised for some areas. While not all of these are exclusively IT issues, there are technology related elements and do provide context for where support priorities might lie.

Several key themes did arise which support the Steering Committee's main recommendations and can help frame future action items. There was broad recognition for the importance of the research enterprise; there is a strong desire to help on all fronts, the aspiration is for 'white glove' and responsive service wherever possible. IT staff often see themselves as brokers or facilitators, guiding researchers to the appropriate supports or advice. The connection between researchers and local IT support is something valued and should be preserved, and supplemented with enhanced core support. Sustainability was noted, as equipment often outlives its normal lifespan due to initial funding, other constraints or changing timelines. The need for more strategic or early planning versus reactive support was identified, though there was recognition that requests can be of that nature for a variety of reasons. A review of support provided by peer institutions indicates that research support is an area many struggle with, though some have recently made an attempt similar to what could be imagined here, as UBC and its Advanced Research Computing services have done in part.

Observations

The workshops revealed a number of internal and external considerations. Overall compliance demands are increasing, particularly in the area of data security. From a maturity perspective, there is heightened awareness in this area, but remains a considerable concern; data management practices are often lacking. The funding model and opportunities are not always well understood or known, as is the case with CFI/IOF support for maintenance. There are differences in levels of support and different funding models, as is the case with CSCF. The need to 'stretch' research dollars, while necessary, may not be institutionally optimal. There was broad agreement

that getting involved early in projects was important. A noted contrast was that we're good at being reactive, but we're in that mode more than we should be. Individualized support is necessary, but it is also very time-consuming which places pressure on limited resources.

Discussion on strengths tended to support the notion that the university and staff have done a capable job in supporting research given the resources available. There is good network access and quality, basic desktop and computing assistance, a moderate level of server and computing resource, some consultation available in creating proposals, help for procuring systems tailored to budget and an overall ability to convert ideas into usable systems. Staff indicated that we are often well-positioned to meet specific needs, but that researchers may not be letting us know what those needs are; greater outreach and a simplified support structure might reach that silent community.

There were many pain points and opportunities suggested; many of these were directed at enhancing what we are able to do with moderate resources and achieve a better standard. This includes providing more in-depth support for specialized software, a more strategic approach to procurement for equipment and other acquisitions versus tactical and 'break/fix' responses, improved software for data analysis and visualizations, data transport and storage, early support for grants and proposals, and addressing some of the lesser resourced or support areas on campus. Other specific challenges noted were for access for campus visitors, providing support beyond ring road (e.g., Schlegel), different support abilities for some institutes (e.g., IQC, Games), access to the Graham facility, the relationship with and changes at Compute Canada and provisioning for post-doctoral fellows. Rising costs and the difference in funding for different agencies (e.g., NSERC and SSHRC) and that impact on IT was also noted.

Discussions also included ways in which researchers could become more involved in administrative or other campus initiatives; an example is the recent local research effort on legal document or contract analysis, which could be of benefit in procurement or other activities.

Scope

Administrative applications garnered some of the strongest feedback, not just in the actual IS workshops, but in many others. While often in the background of the primary activities of teaching, learning and research, they are the engine behind the core operations of the university and in some cases are a frontline interface for faculty and students, as might be the case with Waterloo Works and the coop placement process.

Workshops included IT managers from academic support units and faculties where development, implementation and ongoing configuration and support activities might take place, as well as staff from the ERP and DCA areas within IST and others. The scope of discussions included traditional enterprise level systems (e.g., Unit4, Workday, Quest), other large applications or suites including ExLibris (Library), Home (Housing), Waterloo Works (CEE), RaisersEdge (Advancement), Infosilem (Scheduling) and others. It also covered smaller applications that might be used in singular or a small number of departments, such as Parklane (Safety, HR, Occupational Health), AIMS (Accessibility) and QNomy (The Centre). In all, there are well over 100 systems that would be considered an information system being supported on campus. These come in a number of flavors, including those acquired and vendor supported, such as Archibus used in space planning and management or Vena for Faculty of Math budget forecasting. Others might be developed locally, such as OFIS, Odyssey, ASIS and Evaluate in the faculties, or the Portal in IST.

There are a number of other applications which might match the definition of a typical information system. These were generally covered in more depth in other workshops or related discussions. These systems support functions such as content management (e.g. Drupal/WCMS), learning management (e.g., Learn/D2L, Mobius), identity management (e.g., WatIAM), service management (e.g., Request Tracker), project management (e.g., Jira), data presentation (e.g., Tableau, PowerBI), asset management or email.

Questions

In addition to the general high-level questions posed of all groups, the IS workshops considered some of the following specific questions:

- Does the current suite of applications provide good support for the wide variety of campus processes?
- What are the gaps of most concern? Are there extra systems or duplicates we might consolidate?
- Given the renewal of many key systems, what are the next opportunities or investments that need to be made, in people or systems?
- What are the important considerations in choosing home grown, vendor supported or open source solutions?
- Are roles and responsibilities clear between various units (Faculty, IST, ASU)?
- Do the licensing models used, budget processes or 'who pays' present any challenges?
- Are there external pressures or changes on the horizon that should be considered in the next few years?

Highlights and Recommendations

The priority recommendations from the workshop groups included:

- Governance - There is a need for better governance, which would address such matters as prioritization at a campus level and the complete acquisition process as well as establish a more formal decision-making capability.
- Sustainability and Evolution – This would include more consistent follow-through on project ‘phase two’ plans through better roadmaps, planning, addressing known ‘parking lot’ items, better communication to staff of these plans, lower reliance on singular development resources such as contracts or coop students as well as embracing the need for a continuous improvement approach.
- Engagement – More effective consultation and engagement to ensure that real needs are met and appropriate change management has taken place.
- Integration – Better integration is needed for data that is sourced from these systems, business processes which span systems and in the technical or mechanical ability to link applications.

Other strong recommendations included the need for a better approach to funding applications, in particular where multi-year efforts are required, in order to improve certainty; this might require longer pre-planning windows. Leveraging local talent, in cases where commercially viable solutions were less apparent was also an opportunity. Specific systems were also noted either as a gap or needing attention for support or other reasons, as is the case with CRM solutions, Watcard, Portal or WCMS.

Participants highlighted a number of strengths in this space, including the recent investments made in a number of major areas, system stability and operational support. This was balanced, however, with a sense that the campus was experiencing some fatigue, which made it difficult for providers and users to keep up. Concerns also included the amount of potential duplication in some areas (e.g., document management, scheduling and booking solutions). An outstanding question of where certain needs were best met, and by who, remains for further investigation as part of the overall review theme of roles and responsibilities. Opinion was divided on whether Waterloo was ahead or behind our peers in this area; the answer frequently depended on which area or system was being discussed. Some institutions have benefited from using one platform for major functions, such as McMaster with PeopleSoft. Most departments have advocated for a ‘best of breed’ solution in the past. There was, however, discussion regarding the need to work more collectively in the future. Waterloo has been ahead of other larger institutions at times; our success with the student portal has been praised by many peers.

Observations

The complexity that arises from managing this ‘small city’ ecosystem presents a number of challenges. The lack of a portfolio approach, many projects and upgrades, increased compliance factors, challenges in acquiring or assigning technical and functional resources and funding all combine for a less than agile response. Many initiatives rely less on technology and more on changes to process, where agreement is not always easy to obtain; a process like graduate student onboarding has a number of players, including GSPA, HR, Finance and the relevant faculty units. Lack of agreement or priority have also delayed systems such as a common CRM capability for the full student lifecycle or other contacts; the recent DubHub effort is just now

looking at a basic starting capability. Our complexity can make it difficult for new or infrequent system users, who might have to learn 20 or more applications and interfaces. There are instances where a relatively basic function such as exam management is currently supported by roughly 10 different applications, including those for assessment, seating, scheduling, document production and more. In this case, three different applications with some overlapping functionality regarding assessments have been acquired or developed by different units. The evolution of these ecosystems is often historic; they are good candidates for detailed review.

Changes in technique and technology also play a major role. There has been a recent move from waterfall to agile methodologies. Disruption created by the move to SaaS solutions, which is largely vendor-driven, has impacted roles, necessary skills such as business analysis, funding models, vendor management practices, upgrade cycles, diagnostic tools and other. This change can be positive, as key systems are often more up-to-date with SaaS offerings; maintenance was often deferred historically for cost and resource considerations.

Expectations and positioning remain a challenge as well. As with other services, there is an expectation that information systems match the UW brand. There can be a lack of understanding of the unique needs in particular faculties or other areas; some cited the need to more directly connect with faculty members and students for feedback, while acknowledging the difficulty in doing so. The ability to achieve balance between standardizing on packages or workflows with individual or unit needs is often a source of tension. Some would advocate for being 'ahead of the curve', though some experiences of early adoption of products have shown that there must be a good understanding of immediate and long-term impact when trying new techniques, technology, Canadian implementations or other (e.g., Workday, Waterloo Works, PeopleSoft Student Admin, OnBase for Graduate Admissions). There could be a better track record in deploying the technology that has been acquired; platforms are not fully leveraged or utilized. UW has a large reputation, but is not large in comparison with major commercial players. Leveraging standard services for many core functions, while focusing innovative efforts on more brand related systems is a reasonable position. IT remains a key initial contact point for students with campus and attention to those administrative system touchpoints is warranted on that basis.

The workshops described strengths in the areas of collaboration, a relatively fulsome suite of functionality in total, homegrown applications which have filled specific needs, knowledgeable staff and general management of this complex environment. Other areas for improvement included better service management planning for systems entering production, the elimination of more paper process and manual work, improved business continuity capabilities and more advanced skills for developers, in particular within the larger platforms. Duplications were not just at a system level, but also in initiatives or projects, including several currently underway to manage teaching assistants; these are necessary systems, but acted on by multiple areas.

In all, there was general agreement in such areas as the need to reduce manual work and eliminate paper through BPM workflow tools. Interesting differences were present, where there were contrasting desires from the same audience, such as more local control to implement and develop, but equal concerns about having too many or unconnected systems. Other considerations were based on maturity, where support for experiential learning overall might lag that for cooperative education processes. Ultimately, the workshops identified that the complexity of this space requires a specific review of systems, development of a roadmap, principles and governance, a target state which would be based on available system space, user need, minimizing duplications and other operational efficiency with opportunity for innovation.

Support Services

Scope

This grouping represented one of the more diverse set of services related to information technology. None are exclusively technology based, but rather provide support to the entire campus. Still, they remain a growing and important aspect for ongoing operations. Topic areas for these workshops included:

- Accessibility (e.g., AODA legislation, cross-browser testing, web design)
- Audit and Risk (e.g., project risk tracking, internal IT audits)
- Business Analysis (e.g., workflow design, system requirements and configuration)
- Change Management (e.g., ADKAR, release management, organizational change)
- Communications (e.g., incident reporting, annual reports, service changes)
- Licensing (e.g., contract review, yearly renewals, site and seat methods)
- Privacy (e.g., records management, breach protocols, BIA reviews, CASL, GDPR)
- Procurement (e.g., group and provincial buying, BPS, RFP process)
- Project Management (e.g., tools and resources, PMO, COP)
- Training (e.g., WatITis, PD sessions, LinkedIn, ITPD/SEW courses)
- Liaison (e.g., IST faculty representation)

Participants included staff from Secretariat, Procurement, Human Resources, IST and other from academic support departments or faculties who might play a role in one of the subject areas.

Questions

- Most of these services are not specific to IT and support other broad campus needs. What are the challenges or opportunities as a result?
- Delivery of these services is managed by a number of campus units. Are the specific needs for IT well understood and supported?
- Some of these services are relatively new or have significant new requirements. What are the next logical steps based on need and demand?
- Are there significant new demands, either internally or externally, on the horizon that we need to anticipate?
- What IT supports are required to do your job successfully and are they currently meeting your needs?

Highlights and Recommendations

Priority action areas that arose from the discussions included:

- Rightsizing Efforts – The level of service, scale and rigor required for any effort should be based on scope and risk.
- Change Management – Greater support for this practice was recommended in the areas of training, awareness and available resources.
- Interdisciplinary Approach – Recognizing that these services and expertise cannot exist in any one area alone, a community approach is needed to deal with demand; sharing will need to occur between departments and between the different disciplines.

Other recommendations included the need for better project planning, which might ensure, for example, better commitment of individual time. The need for improved vendor management was also highlighted and should include better tools for monitoring performance, appropriate KPIs or like measures and a shift from the traditional 'relationship' model to one more based on accountability.

Feedback in these specific sessions, and through others, showed an appreciation for these valuable and somewhat unique skill sets. Participants noted that the need and capability was growing in all areas; in cases such as accessibility and privacy, legislation has imposed greater compliance needs on the campus. Further, meeting this demand cannot all be done centrally. Rather, approaches such as a 'center of excellence' with distributed skills across campus was a practical model. As with researchers and local IT staff, these positions were often described as trusted advisors.

There was consistency in these findings, including the alignment with the recent Excellence Canada report related to business processes and the need for a better knowledge management capability. There were, however, a number of notable contrasts. Many indicated a lack of templates, but also spoke to the number of available online resources. The same was true of improved communication overall and a lot of information being shared, but also a lack of awareness of initiatives underway. Some areas remain early in their evolution; the campus has always undertaken some form of change management in IT, but that the formal campus practice is in its early days.

Observations

As a general theme, the growth in demand and capabilities in this area were obvious, though a number come with a small caution. There have been obvious benefits in an established PMO and project management practice, including tools and online resources. Many different sources of training are available and in different forms; with the exception of WCMS training though, none is mandatory. Collaboration is strong within this community and in fact in higher education overall, with a number of CUCCIO SIGs devoted to these services. There is a great deal of expertise across campus, though it may not always be well coordinated. There is good awareness of processes in areas such as privacy and security assessments, though the large demand in these may require new ways of managing such requests. Communication was noted as an area of improvement in recent years. Of interest, there was a real sense that IT can deliver to a deadline, when one is firmly set. Another interesting difference for Waterloo is the relatively low amount spent on consulting and like services for major systems compared to our peers. This has positive impacts on self-sufficiency, though can cause implementations to take longer.

Concerns for support services mirrored those in other groups. Staff noted that early involvement in initiatives for providers is important. Challenges with decisions which are frequently questioned or re-visited, lack of awareness of available services, clarity in roles and recognizing the impact of implementations, were all noted. Internal audits, while necessary from a due diligence and best practice perspective, could be more productive. While there were individual findings for recent reviews, many focused on similar improvements related to documentation, the use of industry frameworks, or noted the lack of a single accountability for IT practice. Some concerns were expressed at the amount of 'red tape' required, even for small projects; some of which was unavoidable, some self-inflicted.

Security and Risk

Information security has been front and center for the past several years as a priority concern, from IT leaders to users of personal devices. The annual Educause top 10 report for 2020 noted security as the number one issue for IT in higher education - the fourth consecutive year for that ranking. Specific concerns raised include phishing and other social engineering threats, end-user awareness and training, lack of resources for security operations, research data, regulatory compliance and other.

The university has responded to these in a number of ways. There are core capabilities within IST, including authentication and identity management (e.g., multi-factor and single sign-on), secure controls (e.g., physical access control and intrusion detection, endpoint protection, video surveillance), risk assessment (e.g., security assessments, vulnerability scanning) and security incident management (e.g., log aggregation and analysis, network security monitoring). Training is available through ITPD courses, and through specialized training arranged for individual groups on request. The university also has connections through CUCCIO and government or other agencies, who share threat information and best practice. There may be additional opportunities, at relatively low cost, to broaden our participation and leverage those services and information to improve security. Special programs have also worked to raise awareness, including recent phishing simulations. During the pandemic, web resources were made available to protect those working from home, including videos on special topics (e.g., DNS security). The Office of Research also performs a key role, serving as a checkpoint for research involving personal information or other compliance. Consultation and review of work falling under CIHR rules, for example, is also available. Health information is particularly sensitive, and found in areas such as Optometry, Wellness and other. Research information can be highly sensitive and require specific protections. The campus is home to leading researchers in the fields of cryptography and cybersecurity, including those involved with the Communications Security Lab, IQC or Cybersecurity and Privacy Institute.

As was the case with the external review, the general absence of feedback regarding security was noteworthy. Possible causes for this range from our experience; while there have been some incidents, the campus has not seen a large number of breaches or a significant large-scale loss of data. There is some sense as well that the community has shown confidence in the ongoing work being undertaken. However, aspects of risk and security were covered in all groups as well as some individual discussions. The lack of a full asset management capability was noted as a weakness in our overall infrastructure. This is a general operational shortcoming, but also a security risk; it's difficult to protect what we don't know. While there are incremental improvements and specific initiatives at the administrative level, the greatest opportunity for improvement and greatest risks were noted in the research area. Promoting a more unified set of services, as noted in the research discussions, would be a large step in improving this situation. Continued vigilance and diligence will be needed to deal with new threats and circumstances will necessary, as shown in the changed risk profile experienced during the pandemic with most staff working from home and students accessing resources remotely.

Several participants advocated for the adoption of a more risk-based mentality and approach to decisions and priorities. This was not intended to imply either a looser or more strict methodology, but rather a more explicit role in decision-making. In the university's regular reporting, IT is shown as having a low appetite for risk. This is definitely true for certain services, such as 'uptimes' for applications on important days (e.g., marks available, rank match information) or network availability. While the economic impact for failures may be not as pronounced as that for large operations like Amazon or Google, the campus tolerance for outages in these areas is historically

low. As well, aspects related to security and information privacy need to be protected and upheld. That said, there are other drivers which might indicate an increasing need to accept risk where appropriate. Such a change in approach will require a conscious choice and management support, due to concerns that errors will place providers under greater scrutiny, whether individually or as a department. Agile development can naturally be riskier, in that not all requirements might be known in advance and implies the acceptance of rework in the interest of better user engagement. More rapid deployment of functionality requires more targeted testing versus full comprehensive test scripts. Conversations can be an aid in managing risk while allowing efforts to proceed. This has occurred, for example, in research that required unique networking arrangements; this can often be enabled with consultation between IST, faculties and researchers.

IT risk management involves the same management principles and steps as in general risk practice, including those of identification, assessment, mitigation and review. The campus risk management program considers elements of statutory compliance, reporting, audit, business continuity and emergency response. IT parallels these, and deals with specific use cases for disaster recovery, system security, lifecycle management and other. Industry groups, such as Gartner and Deloitte have identified a number of current and emerging risk areas for higher education, including records and data management, cloud computing, governance, project backlogs, malware and mobile or end-user computing. Their analysis does not imply imminent danger in any of these, more that these are areas which warrant attention and are commonly reported concerns.

There are many measures in place today to mitigate and monitor risk. These include project management practices (e.g., risk logs and health checks), targeted audits (e.g., identity management, cyber incident response), security operations and services (e.g., 2FA, application security assessments), privacy practice (e.g., privacy impact assessments), disaster recovery (e.g., failover data centers, generators) and specific initiatives (e.g., Linux small applications migration). There remain, however, a number of risks which might require more work. External attacks such as email phishing and ransomware incidents, as experienced by some peer institutions and a number of municipalities, are increasing. Other risks are less obvious, as might be the case with the recent rapid response needed to the 'opt out fees' ruling or economic realities which have impacted coop employment, necessitating system change to support new placement methods (e.g., continuous placement). Other risks might be found internally, in the quality of some data or the timing of budgets and funding. Decisions have been made regarding standards such as PCI, where the University has chosen to reduce work and risk by not locally storing or directly processing credit card information.

In its deliberations, the Steering Committee considered the following questions related to risk:

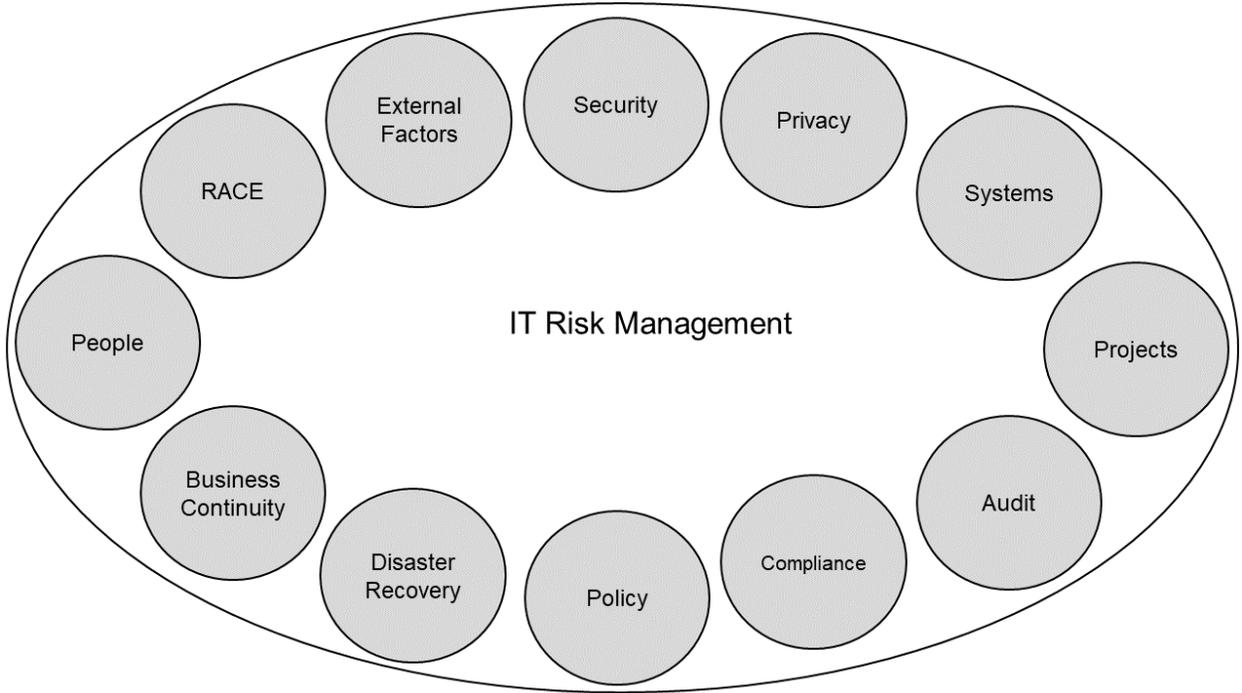
- Based on feedback and findings to date, are there specific areas or aspects of IT where we believe there is significant risk (realized or potential)?
- Are we willing to accept more risk (broadly-defined) in keeping with the innovative brand and spirit of entrepreneurship?
- Are there specific recommendations pending where risk might be a major consideration?

There are inherent risks in IT which have been actively managed, some specific to Waterloo. These span all of the various discussion topics. There are relationships with over 100 vendors which require the active monitoring of contractual obligations and performance management. New Tri-Council funding rules, which reflect global direction, require more formal data management planning and execution. By 2022, the university will need to be compliant with accessibility

legislation, where the requirement is for both internal and external facing web sites and systems. Other areas, such as CASL legislation, may impose financial penalties and may require upgrades in areas such as customer relationship management to ensure compliance. Cooperative education's place and importance to Waterloo represents a unique area of risk, and has historically had significant requirements for supporting information systems and other technology.

While the general tolerance for risk is low, it is reasonable to ask whether there are specific areas where there may be benefits in accepting greater risk. Increased access to and use of information may require an understanding that users will see less refined data and may not always have a full appreciation in some of the nuances behind the lineage of certain fields. A technique proposed within the DSR program would be to provide varying levels of access and tools for classes of users, which might include executive level, analysts or data scientists. While there is general efficiency in fewer solutions and products overall, there may be times when diversity can provide a better experience. More rapid deployment of functionality may require less rigor and a more strategic approach to testing changes. While staff strive to minimize the downtime in any service, there may be a financial trade-off that involves a less robust architecture or 'tiers' in favor of access to more product. In some cases, an acceptance might be more related to culture. Historically, there was broad agreement with internal audit recommendations. Today, there are cases where the university has opted to accept certain IT risks when reporting, due to financial reasons, risk measurement or other practical considerations.

The current IT approach surrounding risk is consistent with and part of the overall Policy 11 practice. However, a more comprehensive framework should be considered. This might include a different approach to internal audit, which would see more targeted exercises and valuable results, in addition to meeting basic due diligence aspects. Other components might include very specific human resource issues (e.g., single points of failure) or broader considerations related to vision (e.g., the balance between efficiency and innovation) and risks associated with various choices there.



Governance

In reviewing the question of governance for IT, the Steering Committee considered a number of elements, including organization and the roles fulfilled by various groups, policy and guidelines that were devoted to or might impact technology, the mandate and structure of campus IT related committees, aspects of vision which cover aspirations and more definitive planning, principles related to prioritization and decision-making and connections to communications or other functions. In the review, we considered the more structured components that might be necessary, but also placed an emphasis on the important less-formal elements that would allow people to work best together and provide a shared understanding of what IT must contribute and consider in its delivery of services. Throughout the internal consultations, it was apparent that some aspect of governance was foremost in many minds. Many of the workshop theme groups placed a recommendation related to governance at the top of their priority action lists. At some level, this is not surprising, as the initial planning iteration for the review itself would have had a scope largely devoted to governance.

In its deliberations, the committee defined the general purposes of governance; these elements were consistent with what was heard in the workshops. At a high-level, it must provide an overall vision, which might include a broad roadmap and individual roadmaps needed for specific applications or infrastructure. These should include current and planned or projected states, support specific needs and focus on core aspects of systems, integrations, assets and like attributes; this is consistent with the knowledge management theme seen during discussions. Governance should provide mechanisms and guidelines for prioritization and alignment, consistent with institution-wide needs and agreed to local accountabilities. Such prioritization should cover strategic, annual and financial considerations. It must also include processes and communication regarding decision-making, whether immediate and tactical or for large complex initiatives. It must be aware of and formulate standards and regulations regarding compliance, whether internally or externally driven. Governance plays a very specific role in projects and initiatives, where we heard a number of concerns with respect to sponsorship and the need for more rapid decisions. It also plays a role in monitoring risk. Not directly associated with 'rules', those involved with governance are key in the promotion of services and success and in an advisory capacity, fostering sharing and the connections or collaborations needed across groups.

While these can be said for many industries, whether higher education, health care or local government, its prevalence in discussion indicates that there is both concern and a need or desire for a better understood approach and framework for governance. This does not naturally lead to a more central position, but rather efficiency, clarity and visibility. The existing landscape includes internal policies (e.g., statement on computing use, Procedure 1), external compliance (e.g., PCI, AODA), organizational mandates (i.e., faculty, ASU, IST), budget processes (e.g., University fund project submissions), functional processes (e.g., requests for video surveillance), committees (e.g., Web Steering, CTSC), agreements (e.g., OCUL and TUG, vendor contracts), external structure and framework (e.g., OSAP, SMA) and other.

There were a number of specific observations made with respect to the existing set of committees that were either devoted to IT or had an important connection to it. Many were noted for their value in sharing information and in maintaining relationships in a large diverse environment. In some cases, they are instrumental to the success of initiatives, as is the case with steering bodies for ERP projects. There are a large number of committees, a number of which operate without an official or out of date terms of reference. The delineation between advisory versus decision-making groups is also not clear; some are purely advisory, some clearly have authority, where others make de facto decisions without a formal role. UCIST, the most senior IT committee overall,

is advisory to the CIO. Groups may be formally 'sponsored' through senior leadership (e.g., Workday/HRMS portfolio) or less formally (e.g., Advancement portfolio). There are relatively few official reporting relationships or connections between groups, however. CTSC, for example, would report through UCIST; other working groups such as the student advisory group are less formally sponsored by Client Services in IST.

Consistent feedback provided through the workshops included the following themes:

- Level of Consultation – Change, whether a new implementation or change in service or process, can require extensive consultation; this can create long cycle times. There is agreement regarding the importance of buy-in and consultation. Resolving the potential conflict between these needs and the concerns regarding responsiveness and lengthy times to implement will be important.
- Approvals and Decisions – The lack of clear decision-making structures and the re-visiting of previous decisions or lack of adherence and follow through with these or other agreements and the subsequent impact on staff and time was a concern. There are also examples where the institution has had to either cancel or adjust agreements made with external agencies or potential vendors due to insufficient review and approvals beforehand. These are reputational and security risks, for example, to the university.
- Budgets - The new accountability-based budget model provides funds for IT projects as part of an overall campus special initiatives fund. This process continues to evolve, which along with government funding changes, has led to additional uncertainty in yearly planning. The model also has different implications and impact for faculties and ASUs and IT as a result. There is also obvious tension felt by staff in the need to affirm the value of certain services and other spending.
- Role Clarity – There are services and individual circumstances where the accountabilities between units or individuals are not well understood or defined. These situations are not confined to one particular aspect of IT, but may include the selection of technology, application support or decisions regarding compliance.
- Size Factor – Larger units, whether ASU or faculty based, may have the resources needed to move more independently. This difference has, at times, created concerns with consistency or equity of services.
- Innovation – A well understood approach to multiple options, local systems and optimization and their relationship to core services is lacking; governance plays a role in this.
- Planning – There were numerous examples cited where the campus is more focused on immediate or tactical need and where joint or longer-term planning has been lacking (e.g., information systems and department coordination, infrastructure planning, multi-year budget needs).

In order to address these, a number of essential elements will need to be put in place. These include responsive abilities to provide quicker and sustained decisions and solutions, reaffirming principles related to IT's role in supporting functional or business needs and communicating available options, which includes first considering what the university may already have 'on the shelf'. A model will need to include the whole community, and address the balance of centralized and decentralized services, our vision with respect to differentiators versus core commodity capabilities and position with our peers. These will need to be visible and provide clarity regarding the lines of authority and include a pro-active and systematic approach to prioritization. In parallel, it will require a new strategic plan which can describe the focus for the coming 5-year period. There may also be a need for parallel changes or other support within the university. In many

cases, challenges for IT arise due to lack of clear ownership for some business process; the ability to address these, in particular where processes span units, is crucial. A specific case will be providing a framework which might support local efforts for administrative system development, alongside the work done centrally. Other parallel efforts might involve work with HR and units, in order to achieve greater staff movement and any equity considerations if that is an objective. Flexibility in any model will be necessary, as some areas might require different levels of governance. For example, some elements related to security could involve tighter control moving forward; guidelines related to sustainability and climate change may be more aspirational.

7. Other Observations and Considerations

During this review, a wealth of possible suggestions was received. While not reaching the threshold of a major recommendation, the committee felt it important to capture a number of these for consideration by campus IT management and staff. In a number of cases, progress could be made independently from any formal action on a major recommendation.

- a. WIFI – An RFP for a major WIFI refresh has just been completed and award made; upgrades include specific work for campus, residences and some AFIWs. This represents a significant investment over the next 4-5 years; this is a typical cycle due to changing and increased demands. This should, with appropriate prioritization, address many of the immediate and overall concerns with this service.
- b. Business Analysis – As with the recent demand for greater project management skills and practice, the need for continuous improvement and necessary business analysis and business process skills across campus is evident. There is a growing capability, with more resources now in some ASUs, analysts in IST or as part of campus Lean/CI initiatives. A coordinated view to this practice, which is not strictly IT focused, would be beneficial.
- c. Sustainability – Elements of sustainability are indicated in the body of the report. There are specific initiatives or actions, such as those that might impact the IT ‘footprint’, which could be considered independently from broader recommendations.
- d. Business Continuity – The current pandemic will provide a number of important lessons and other information related to our overall business continuity planning and abilities in IT. A broader study will be worthwhile at the appropriate time and should consider questions on the value, approach and delivery of common central solutions and where flexibility and diversity might provide specific strengths to the campus. A number of surveys have been conducted or are in progress in the areas of access and connectivity, teaching and learning tools, enrolment intent and other, in order to assess current state and for planning purposes.
- e. Process – The review identified a number of concerns with respect to specific business or functional processes. A focused exercise which would solicit these from the community, combined with other known pain points and prioritize these for improvement should be considered. Onboarding was one such example; this arose in technical discussions related to provisioning and authorizations, learning new applications, and processes which spanned units for individuals such as graduate students.
- f. Campus Services – Discussions on the broad set of support services identified a number of cases where IT staff, such as project managers or others with unique skills, were providing support for initiatives and other departments beyond a traditional IT mandate. As with business analysis, further study might inform how best to assess these needs, grow the various capabilities and determine whether these could be better served through a core ‘business office’ or other methods.
- g. Accessibility – Our web presence should comply with Web Content Accessibility Guidelines (WCAG) 2.0, Level AA. Progress has been made in the migration of web sites with work expected to be completed in fall 2021. There may be other opportunities to

leverage the central Drupal platform to help ensure compliance. A review should be conducted to ensure that all necessary applications and sites meet these guidelines well in advance of target dates.

- h. Infrastructure – Several initiatives, now underway or contemplated, will alter the footprint for local server and overall data center needs. These include the move of the WCMS to Pantheon and other administrative systems to off-premise environments. This is a continuation of the general trend toward cloud provisioned services. Notwithstanding any overall cloud statement or direction, specific planning for server renewal and upgrades and other physical facilities should be undertaken given the amount of ongoing support and potential capital renewal costs. Consideration for other change, in part as a result of the pandemic and new service delivery methods, may be needed for classrooms and for student computing labs.

8. Closing Remarks

The COVID-19 pandemic served as an unexpected backdrop for the completion of this review and indeed for the campus as a whole. It demonstrated the importance in certain technologies - collaboration tools, knowledgebases of information of different kinds, video and other capabilities to support working from home, online resources for course materials, administrative tools that were easy to access, secure access through VPN where needed, and in general provide the best possible user experience under the circumstances. It also highlighted some of the areas where resources might have already been stretched, or the importance of robust integrations, such as video tools accessible from within Learn and international access. Not all of these could have been foreseen, but all provide important lessons that support a number of the most common findings and key recommendations. The ability to work together and provide a robust easily accessed suite of IT services and resources was readily apparent. There are interesting lessons to be learned in the rapid scaling of services, or quick investigations and deployment of tools to support electronic signatures or remote proctoring of exams

Though captured in different ways, a common and prevalent sentiment came through during consultations. When it comes to information technology on campus, we have a lot of strength in our people, whether in their skills, overall resource available, the will to serve and desire to improve. Our task now is to provide guidance in terms of vision, governance, planning, priorities and support which will allow them to succeed.

The committee recognizes that the priority recommendations indicated in this review will need to be considered in the broader context of work and other action items that might require the attention of the campus in the coming months as a result of the pandemic. Specific actions will be contemplated for the 're-opening' of campus, including potential options for telephony, workstation 'hoteling', video conferencing and other change. As a result, actions and timelines might depend on the availability of senior leadership, funding where some investment might be indicated, necessary process changes and efficiencies or other priorities. It was, however, important to recognize and capture the thoughts and work of all participants who devoted time and energy; many are longstanding items which can be addressed as the campus returns to a new normal state.

Appendices

Disclaimer: The material contained in these appendices does not reflect all of the resources gathered and consultations held, but is representative of some of the key elements used in the development of the report.

I. Steering Terms of Reference

Campus Information Technology Review

Background

Information technology represents one of Waterloo's largest investments in terms of human and financial resources. It is a critical administrative process enabler, a key pillar in supporting teaching, learning and research activities and plays an important role in student experience. Expectations for information technology at UW are often high due to the nature of the institution. Over the past several years, there has been a significant period of renewal in our information systems and infrastructure. There are, however, external pressures in terms of a changing technology landscape and new funding realities. The last full review of IT was completed one decade ago in 2009; now is a most opportune time to assess this overall university capability.

Purpose

The purpose of the review is to identify ways in which the delivery and value of IT services on campus can be made better for the benefit of the institution. Important aspects will include identifying opportunities to enhance efficiency and effectiveness, improving user experience, minimizing risks to the organization, providing clarity regarding roles and responsibilities and responding to new internal and external pressures. This will be accomplished by examining our current and desired future state, comparing with our peers in higher education and identifying known pending changes or important trends. The focus of this exercise is on campus IT overall and not intended to be a review of individual units. As part of its mandate, a number of important questions will be posed to the campus, including:

- What are the significant gaps in services or in levels of service? Are there capabilities which might no longer be required?
- There are a number of examples where multiple applications appear to perform fundamentally the same function. What are the reasons these have been either acquired or built and then implemented?
- Are there opportunities to adopt 'best of breed' suites of services, rather than individual point solutions?
- Where should decisions be made regarding our overall technical infrastructure and architecture? Where should decisions for priorities, efforts and expenses be made?
- What are the greatest opportunities for a more effective use of resources?
- Are IT projects, services and overall capabilities aligned with existing or pending University strategic directions?
- How do we ensure that solutions and services are sustainable over time, from both a people and financial perspective?
- Where do individuals look first for technology support? Are faculty and staff aware of the services offered by the various units on campus?
- What is the overall vision for campus IT? Should it be a differentiator in alignment with the UW brand?

Steering Committee

This committee guides, assists with community engagement, verifies scope, considers findings, confirms recommendations and provides overall support for the review process. Its constituency is intended to provide broad representation of key campus stakeholders. It is expected that the group will meet monthly or as required to complete its mandate.

- Bernard Duncker - AVP Interdisciplinary Research, Office of Research
- Kevin Hare – Vice Dean, Math
- Karen Jack – University Secretary
- David Kibble (Chair) – Strategic Consultant, IST
- Beth Namachchivaya - University Librarian
- Cathy Newell-Kelly – Registrar
- Robert Park – Associate Dean Coop, Arts
- Richard Staines – Associate Dean Research, AHS
- Allan Starr – Associate Provost, Institutional Data, Analysis & Planning
- Sean Thomas – AVP Advancement Services, Advancement

Timeline

The review will complete its work no later than one year from launch. A tentative timeline is as follows:

- Initial Planning and Research – April/May 2019
- Internal Self-Assessment and Focus Groups - June/July/Aug/Sep 2019
- Preliminary Findings – Oct 2019
- External Review – Nov/Dec 2019
- Consolidation, Draft Report and Review – Jan/Feb/Mar 2020
- Final Report – Apr 2020

Discovery and Consultations

The review will identify and consult with appropriate constituencies and stakeholders from the campus. It is anticipated that much of the discovery will be in the form of individual sessions and focus groups. It will also consider models and approaches used at peer institutions which are a source of best practice and lessons learned. As well, there will be an external consultation with select stakeholders (to be identified).

Deliverables

The results of the review will be a written report, endorsed by this committee and delivered to the Provost and CIO. It should address the questions above, along with specific recommendations that will help ensure that Waterloo's information technology capability is sustainable, aligned with our strategic directions, meets campus needs, uses resources in an optimal manner and is well-positioned to respond to internal change and external change.

II. External Review Report

University of Waterloo
IT Review
External Review

October 28-30, 2019

Bo Wandschneider
Chief Information Officer
University of Toronto

Sean Reynolds
Vice President IT and CIO
Northwestern University

Report: January 3, 2020

Summary

The following report provides a summary of the external IT review conducted between Oct. 28-30, 2019. The review was well supported by the University of Waterloo community, with the participation of over one hundred faculty, staff and students¹ including significant University leadership participation. The commitment to the institution and to improving IT services delivery was very evident by the preparation, passion, creativity and openness that the participants brought to the process.

Consistent with what we heard from the community, this review document identifies findings and recommendations in many areas of IT delivery across the spectrum of supporting organizations, structures and activity areas. None of these will be a surprise to those involved in the delivery of IT, or to those who were involved in the review process. They are highlighted in the following summary paragraphs.

- 1) Move to a more institutional view of IT: The University of Waterloo would be well served by developing and articulating a common vision and embarking on a more holistic approach to IT. An overarching strategic plan, re-envisioned governance, and clarity of roles would reduce some of the current friction in advancing IT functionality and delivery.
- 2) Clarify the role of the CIO: The role of the CIO has to be clearly defined and articulated with respect to accountability and authority for IT from a campus-wide perspective. This leadership and accountability which extends beyond IST needs to be based on a collaborative and partnership approach with appropriate governance, visibility and University leadership support.
- 3) Better alignment of existing resources - service delivery, staffing: The report makes recommendations for a more planned and integrated approach for IT service delivery across the central and distributed units. More purposeful planning and governance can lead to more integrated service delivery, development, support and improved outcomes.
- 4) Unified strategy for system adoption and development: An overarching strategy and more collaboration across all of the business units and Faculties will lead to more effective delivery of systems for the campus. Independent decisions, leading to a best of breed and ad hoc system improvement approach, with the gaps being filled in by whoever identifies them can be overcome with an overarching strategy, and campus-wide participation in planning, prioritizing and developing system deployments and improvements.
- 5) Information Security: We are adding information security as a foundational area because we believe that it necessitates the actions described above. As campuses increase their information security posture, it is necessary that the foundational elements of an information security program, including governance, accountability, and clearly defined roles and responsibilities are commonly understood across the University. This is an area that is becoming part of the culture at peer institutions and given the University of Waterloo's distributed approach we feel it is an area that requires more institutional attention.

¹ The session with students was a good discussion, however we felt that we would need more time and breadth to put forward specific recommendations related to students. Their input exhibited general satisfaction but also confusion related to wayfinding of tools and services, and confusion related to the need to seek central or departmental support for various IT issues.

Specific findings and recommendations are also identified in the areas of research and teaching, but the issues identified above are foundational and are essential to more effectively support the breadth of IT activities at the University of Waterloo.

Acknowledgements

The following document provides the findings of the external IT review conducted between Oct. 28-30 2019. We want to start by thanking the University of Waterloo community who actively participated in the review. We heard from over one hundred participants from across the University, including students, staff, faculty, Deans and the Provost. It is clear that the institution recognizes the importance of information technology in contributing to the mission of the University and demonstrates the personal commitment of so many to furthering the capabilities of information technology.

The community is very interested in exploring opportunities to advance the IT landscape at the University of Waterloo to more effectively meet institutional needs and to ensure that IT service delivery is better aligned with the institution's reputation for innovation and technology excellence. People had a great deal to say and share, and the University of Waterloo may want to consider a way to continue with some of these discussions post-review.

We would also like to take this opportunity to thank David Kibble for his leadership, participation and facilitation of this review. A great deal of work has been done to gather insights into how IT is supported at the University and to help us understand the environment. The trust that the community has in David set the stage for very engaging discussions. In almost all cases the frank and constructive discussions could have continued beyond the allotted time.

Background

The University of Waterloo has a number of strengths that gives it the opportunity to deliver strong IT programs in support of its mission, and to be a leader in IT service delivery in the higher education space.

First and foremost is the strengths its' people. It was acknowledged throughout the interviews that there is deep expertise in IST and talented IT and subject matter experts in the academic support units. The Faculties compliment this with creative staff that possess strong local understanding of requirements and strong IT skills. All of this exists within the culture of academic leadership in technology and information technology that the University of Waterloo is well known for internationally.

In addition to the people, the University of Waterloo has been a leader in providing solid foundational infrastructure. Whether that is the enterprise systems that have served as a reliable infrastructure for the administrative systems or the recent upgrades of the network infrastructure, the technology foundation is solid.

Consistent with other universities information technology use has grown dramatically over the past several decades at the University of Waterloo. Related development in IT support has also evolved, largely in an organic way. The result of this evolution is distributed IT delivery with IT support occurring in central and distributed units. While this organic growth of information technology served universities relatively well during the initial period of rapid growth and increased adoption, universities have been undertaking reviews and actions to purposefully define roles and delivery approaches to ensure that IT opportunities are broadly made available

and that unnecessary duplication or requirements for integration are not overly burdensome. Participants broadly discussed this issue citing gaps in service, duplication of effort and shared concerns regarding sustainability and to a lesser extent security. Wants have exceeded the ability to meet them, and there is not a clear understanding of how competing needs are prioritized, how resources are allocated and where accountability rests.

It is important to note that there is a strong desire for change and many feel that now is the time to look for opportunities to mature the IT landscape at the University of Waterloo. This was heard at all levels across all faculties, and strongly at the meetings with senior leadership. Capitalizing on the new strategic plan with the strength of conviction that “Waterloo is built for change,” new leadership in key roles, and a new budget model, combined with external pressures such as provincial fiscal challenges and external IT drivers presents an opportunity for change.

Driving this type of change in a research-intensive university like the University of Waterloo can be challenging. The very structures that support research-intensive institutions like the University of Waterloo can also be an impediment to change. A frequently heard assertion was how distributed the university was and that this was the “Waterloo way”. Similar statements are made at other universities and although it is always true, holding to this too dearly can detract from meaningful change. Enabling the “Waterloo way” to be a barrier to discussion of change will be a challenge to overcome, and needs to be addressed.

We heard that the Faculties value central solutions, but want local control to address unique local needs or short-comings of these central solutions. The university clearly values localized decision-making and the subsequent agility this affords. There is a perspective from the Faculties that the delivery of solutions at an enterprise level slows the pace of development of IT solutions. Acknowledging that Faculties have common needs that can be met with central solutions, but may also have local needs which may be different from other units (solutions or service expectations) it will be important to develop a framework with a shared vision and guiding principles that ensures consensus-building and flexibility to deliver an effective and more seamless IT ecosystem. With the level of distributed delivery across the Faculties at the University of Waterloo being so high, this area needs to be considered more deeply. With this distributed strength it is even more important to have strong governance and a clear understanding what is provided at the enterprise and what is provided by Faculties.

During the 2.5 days of interviews, we noted a fair bit of consensus on the major issues, although, as expected, there were some divergent perspectives on specific issues, both in terms of the relative importance and impact, and the underlying value. We will report on the significant themes and we will attempt to identify where there may not have been consensus, or where the perspectives of value were different.

Findings

Overall IT Organization/Structure

Consistent with the most research-intensive universities, the University of Waterloo IT environment is a distributed support model. Our observation is that the degree of distribution is higher than peer institutions and efforts to coordinate activities between the central/enterprise department and the distributed environments lags the trend toward a more holistic and integrated approach that is developing at other universities.

The model of support that is most generally adopted is that the central providers are responsible and deliver the underlying baseline infrastructure and widely used systems and support.

Examples of the activities of the central/enterprise department generally include:

- Oversight for the IT strategic direction of the University
- Provisioning of core IT infrastructure, networks, systems and services to the University
- Enabling the integrated campus-wide approach to IT (governance, policies, communications, facilitation)
- Providing the environment for interoperability on campus or beyond
- Responsibility for an integrated campus approach to information security

The role of the Faculty or departmental support is to build on, and/or integrate with, the infrastructure, systems and services provided by the central/enterprise organization to meet increased unique needs of the units. Examples of the activities of the local IT support generally includes:

- Provisioning in areas of specialized needs
- Customized services and support
- Enhanced service levels, on-site, personalized service
- Subject matter and discipline specific expertise

As happened throughout the sector, the University of Waterloo IT support model has grown organically with the result that there is a lack of clear definition of roles and responsibilities or sufficient coordination in the delivery of IT across campus. Infrastructure and applications that are universal or enterprise in nature are purchased, developed or supported locally sometimes resulting in:

- Duplication of services resulting in less than effective use of scarce resources and a greater total cost of ownership (TCO)
- Lack of functionality being extended more broadly, creating significant disparities across units in IT and/or the inability to effectively scale services
- Confusion about what services are provided and who is providing and supporting them.

The University of Waterloo has an opportunity to leverage the skills within Faculties by undertaking a more federated approach to the delivery of IT systems and support. With the combined strength of the staff in IST and the academic support units, and the Faculties and departments, the University of Waterloo is well positioned for a more federated approach to IT support that amplifies the benefits of both central and distributed IT support. Discussions with Faculty IT leaders supported the notion of building a more integrated support model leveraging the skills, resources and priorities of distributed IT units to complement the activities of the central units. This in turn ensures that innovative solutions originating with the Faculty take into consideration the broader communities' requirements and are effectively able to scale (technology and costs). Necessary elements for success with this model include a common understanding, effective governance, clear decision making, a high degree of collaboration between teams and individuals, effective ongoing communications, and trust.

Recommendations related to IT organization:

1. Build on the University of Waterloo strength of resources to more purposefully integrate the activities of the central and distributed units and staff through a more federated approach.

2. Engage in a process that moves toward consensus, defining the various roles of the IT units at the University of Waterloo. Identify roles, responsibilities and accountabilities. This common understanding is a necessary condition to having a more holistic approach to IT on campus.
3. Clarify senior leadership support for the resulting approach (provostial, decanal) to ensure understanding and commitment to this direction.
4. Ensure that the enterprise IT group has sufficient resources to partner with the Faculties in the development of innovative services.
5. At a tactical level update and analyze service catalogs for each unit providing IT services to understand what is currently being offered, to identify areas of current risk, and to test the future model of delivery.

Governance

Effective IT governance is critical to the success of a more shared IT model of campus support to ensure:

- Alignment of the University, Faculty and department objectives
- Common understanding of needs and appropriate prioritization
- Oversight of standards and approaches, and
- Effective communication and coordination of efforts and development

IT governance at the University of Waterloo is inclusive of the Faculties and departments and spans the roles of decision makers, providers and consumers of IT. Even with this robust structure, throughout the review we continually and universally heard concerns related to the effectiveness of IT governance. General observations were that the current model of governance is not adequate, lacking true decision making or advisory roles, and effectively being about information sharing.

Consistent with the roles and responsibilities in the organization section, it was noted that it is not clear where the authority, or deep recommending responsibility lies. The conclusion is that decisions are made outside of this structure and that at times committees trip over each other when they do try to set directions or priorities. The result of this was a spectrum of responses to decision making that included:

- Committees do not make decisions or set priorities
- Faculties and departments make decisions independently
- The CIO decides about enterprise solutions and infrastructure
- The provost decides
- We have no idea, it just looks like a black box

A common theme was that IT governance needs to improve and IT planning and delivery needs to move beyond the current “relationships based” approach. Clarity of roles and relationships between committee is needed.

A sub-theme of governance that was discussed in a number of meetings was in the area of IT policy. This was an area of sensitivity for those who discussed it. Whether it was leadership, or staff from IST, or the Faculties, there was acknowledgement that additional policies (going beyond standards and guidelines) related to IT could be helpful – even necessary, although it was generally accompanied with hesitation based on it being a contradiction to the Waterloo

way. This is an area that we believe will continue to create tension and will be resolved with additional policy over time, driven by current and future requirements, especially with emerging needs around information security.

Recommendations related to IT governance:

1. Conduct a review of the IT governance structure, clearly defining roles and responsibilities and relationships to other committees.
2. Consider a governance model that ties the activities or participants across roles. Whether this is an overarching steering committee or cross representation on committees, additional linkages will help overall effectiveness. For example, might the addition of a member or two of the Computing Technology and Services Committee (CTSC) on the University Committee on Information Systems (UCIST) committee ensure linkages that improve communication?

Leadership

The current leadership of IST received strong endorsements from the community for strength of relationships and support for partnership with the Faculties and departments. In fact, the only concern in this area was the desire to have more access to the CIO by some of the school IT staff. However, we need to note that this strength of current leadership should not mask the importance of building some level of structure and effective governance to support leadership in the future.

It was not clear that the IST leadership had visibility or authority for IT activities from a comprehensive University perspective. Where many institutions clearly define the role of the CIO as the senior-most IT leader on campus with accountability, responsibility and authority for the entire IT landscape, this does not seem to be the case at Waterloo. This is not to imply that all IT activity should be within the organizational purview, or budget, of the CIO. However, it does mean that the CIO is accountable for the success of the overarching IT environment, the delivery from a campus-wide perspective, and the oversight and structures for integrated planning and service delivery. To enable this, the CIO has to be recognized for having this authority and visibility into all IT activities throughout the campus.

One note of caution that was made clear by leadership, faculty and staff during the review is that this authority cannot be heavy handed. The “Waterloo way” means that this will only be successful with leadership (like the current), who are very collaborative, understanding of the importance of the roles of the Faculties and departments in the delivery of IT and where there is understanding and respect for the IT related roles which are closer to the mission and business of the faculty and staff at the institution.

Recommendations related to leadership:

1. Ensure the future success of the CIO and other IT leadership by supporting the functions with appropriate structures in governance and organization of IT.
2. Ensure visibility into cross-campus IT activity for the CIO. Consider implementing oversight through governance, through visibility into IT spend across campus, and through position approval.
3. Clarify and articulate the role of the CIO including the following as areas of functional responsibility:
 - a. Direct management authority for budgeting and financial results of IST

- b. Chairing the top-level integrating information technology governance group
- c. Subject to policy and as delegated by the top-level governance group, the CIO has approval authority over IT spending. This would include spending within the Faculties, over a designated threshold to ensure ongoing transparency and discussion related to overall campus IT activities.

Communication

Communication is always a challenge in complex higher education institutions. The cliché would suggest that you can never communicate enough. Although we heard many concerns about a lack of communication we also heard of examples where communication was considered good. Some areas of note were:

- Generally, communication was perceived to be better between IST and the Administrative users than it was between IST and the Faculties
- Some communication and engagement in areas such as at the project level is very good
- Communication about priorities, plans, and decisions is less effective
- Effectiveness of communication wanes at the grassroots level of the organization
- Understanding the campus IT landscape and activities across campus would benefit by having more awareness by all those involved

Recommendations related to communications:

1. Develop more effective channels to communicate with constituencies: it would benefit the University of Waterloo to continue to explore opportunities to more effectively and efficiently develop channels to reach its busy constituencies. There is no successful “one size fits all” communications strategy, but attention in this area is a critical underpinning to gains discussed about clarity of roles and governance.
2. As demonstrated with the strong engagement during our interviews, more opportunity to have the community provide feedback would be well received and help in establishing understanding, trust and collaboration.
3. A particular area of attention for communication would be across governance groups. Objectives, minutes and annual reports would be shared outputs that would benefit all those in IT connected planning and delivery roles to better gain visibility into plans and activities.

Staffing

It is very apparent that Waterloo has talented staff with very specialized skills, as well as more broad skills centrally and distributed throughout the University. Questions that probed to understand the engagement of the staff resulted in anecdotal support for some positivity in this regard, with a very high retention rate being an indicator supporting this assertion.

An area of concern, is in the approval process related to IT positions across campus. It was communicated that position postings simply appeared without any thought to an overall strategy. It wasn't clear if there was concern about equity, or if it was concern for resourcing or missed opportunities by adding staff within units without ensuring optimal gain to the campus of this investment. As reviewers, with limited insight, we might extrapolate to the latter.

Another theme identified in the area of staffing was related to opportunities for career development or job change by gaining new roles in different units. Having opportunities to move to positions in other units was seen to be a desirable outcome for staff, and the University, as these changes and related linkages will help build a more cohesive IT community. Given the challenges in recruitment and retention within the Waterloo Tech sector the University needs to think creatively, especially in terms of job satisfaction and retention.

Recommendations related to staffing:

1. Consider developing a campus staffing plan for IT that reflects the overarching strategy related to IT delivery on campus.
2. Ensure new models of service delivery (e.g. cloud) are considered in the staffing plan and support staff in the identification and development of skills related to these changes.
3. Consider different models of staffing where Faculties or units have local needs and opportunities to hire that will extend the benefits more broadly (joint appointments, matrix management, additional secondments, etc.).
4. Actively encourage and support staff mobility across units. Process change related to alerting or posting positions might be part of this.
5. Consider a position approval process for IT related positions that include Dean's and the CIO.

Service and System Delivery

The desire to work more collaboratively across units does not happen naturally even with the current committee structure in place. This leads to many different solutions, providers, integration requirements, and different experiences with the following additional impacts:

- Confusion exists for faculty, staff and students as to where they go for assistance. The result is different depending on whether the service or solution is delivered centrally or by a faculty or department.
- Independent development approaches result in issues related to scaling solutions and providing support beyond the source department.
- User experience difficulties exist within and across disparate applications. This is related to support and training, or related to system and data integration.

IST and Faculty IT leaders are taking steps to reduce the impact of these autonomous approaches. An example of this is the recent creation of the Faculty Academic Support Team (FAST). FAST is made up of faculty-based developers with an aim to create a more integrated support model leveraging the skills, resources and priorities of distributed IT units to collaboratively develop solutions to augment the central solutions. Extending this to include IST and integrating it into the broader planning structure will ensure that innovative solutions originating with the Faculty take into consideration the broader community's requirements and are effectively able to scale (technology and costs). Specific actions identified to date include defining standards and collectively resourcing (e.g. peer reviews of development) initiatives.

Another example of a recent success in integrated approach to service delivery is with the Project Management Office which was lauded for its success in leading IT projects and projects that went beyond IT implementations. Building on the success of this group by bringing together many units in support of common goals would be a logical extension of this success.

Recommendations related to service and system delivery:

1. Support collaborative initiatives such as a modified FAST (described above) or the integrated Professional and IT Support Services working group to ensure more integrative capability and support across the University.
2. Consider developing an integrated service catalogue, over time, to provide a holistic inventory of IT services and enable way-finding for the community.

Funding and Budget

Although the review did not include a focus on funding, the consultations surfaced this as an issue in a number of ways:

- Partners and Faculty based staff indicated that they felt that funding did not always enable attention to projects in a timely fashion
- Concern by many related to ensuring responsiveness and agility in IST
- Concern that minimal investment is affecting the delivery of services and jeopardizing the keeping of infrastructure up to date and secure
- Uncertainty about the new revenue attribution model and what the impact will be on campus IT delivery
- Uncertainty by Faculties about what the units are getting for the dollars spent on IT

Given that generally, in publicly funded institutions, demands have far outstripped our ability to deliver, it would be easy for us to say that more resources need to be devoted to supporting information technology. That is clearly a challenge within the current fiscal climate, but there are things that can be done. Based on experiences elsewhere, we think that a reallocation of existing resources to focus more intently on common goals could make more effective use of the existing resources.

Recommendations related to funding and budget:

1. Align IT investments to drive infrastructure and service delivery, as defined through the activities above, related to IT organization, governance and service delivery.
2. Conduct a study of IT expenditure across the organization to understand opportunities for improving IT delivery and making better use of current expenditures. Monitor what schools like UofT, UBC, Alberta, McMaster and York are achieving through Uniform.
3. Under the new budget model look for opportunities to invest in strategic, campus wide IT initiatives. We have heard anecdotally that one prominent Canadian university is using some of their foreign student tuition revenue to create capacity for strategic IT initiatives, versus operational activities.

Administrative Systems

The area of academic support systems and administrative systems was the area where we heard the most feedback related to opportunities for improvement. Topics that came up repeatedly included:

- Lack of clarity on how things were prioritized
- Little transparency on where purchases or development occurred

- Minimal direction on whether and how systems stayed local or were promoted to the enterprise

The central business units and IT understand it is their responsibility to deliver enterprise level systems. Faculties and units generally believe that it is their prerogative (or even their responsibility) to extend the functionality of these systems by purchasing, or more often developing locally. This is done to meet the needs of an individual department, or sometimes a collection of units. Additional reasons for this local advancement are related to capacity, capability, control, and agility - some of which is not possible through the central environment.

Issues identified by central providers, and the distributed units, were consistent in that they recognized that this created:

- An environment of haves and have nots
- Difficulties in extending capabilities beyond the local providing unit
- Ongoing support issues for the Faculty or unit, or support issues if the central unit inherits the application
- Risks in sustainability related to the technology stack or programming approach, or related to single-points-of-failure with distributed developers
- Integration issues

In addition to issues related to prior recommendations of organization/structure, governance, and communication, which will be required to advance this area, is the need for an overarching strategy and approach to these systems. The selection of solutions is generally done at the business unit level. For example, HR selected their system independent of the selection of the other major systems. The timing of replacement and priorities for investment across the systems was stated as being opaque to many. The improvements and process to advance these systems is done locally by either the system owners or schools and departments. The absence of integrated or commonly understood long term and short-term plans across the portfolio of administrative systems will continue to be a contributor to the somewhat chaotic development of the systems.

Another area that was referenced throughout the review was the effective use of institutional data – something that many Canadian Universities are struggling with.² There was also a shared understanding that this is not specifically an IT issue, and is more related to stewardship and sharing, data definitions, privacy, etc. It was noted that IT could continue to help advance this area, especially in supporting the promising recent work of the “Data as a Strategic Resource” program planning initiative related to defining the overarching data program, governance, priority setting and identification of pilot projects.

Recommendations related to administrative systems:

1. Build a cohesive strategy for enterprise administrative systems in partnership with functional units, especially in light of the unavoidable transition of these systems to the Cloud.

² UBC has an interesting level of maturity in this area that would be worth exploring. In addition, CUCCIO has recently created a Data Governance SIG (Special Interest Group) to discuss shortcoming and developments in data and analytics with a goal to include the broader community beyond IT.

2. Ensure that the governance of the functional areas is inclusive of business system owners, IST and Faculties. Faculty based representation should include both business leaders and technical leaders who can represent both the business and technical opportunities.
3. Develop a roadmap for major system developments and related system improvements informed by the central units and the Faculties.
4. Support the Administrative Information Governance Committee (AIGC) and related data program initiatives.

Research Computing

At this time research computing is embedded in the Office of Research with SHARCNET funded positions, and in the Faculties, Centers and Institutes. IST does provide general computing support for interdisciplinary research units and have centrally funded “account representatives” for most Faculties. Discussions between the CIO and the Associate Deans Computing about possibly redefining some aspect of these roles into HPC and scientific computing support roles are at the nascent stage.

In the session with researchers, it was emphasized that support for research often took non standard approaches and in general all levels of the organization support the researchers’ requirements. To this end, it was emphasized that local IT, with the necessary understanding of the research area, is critical in this space. However, it was also noted that this resulted in a siloed approach which made it difficult at times for researchers to navigate their way for infrastructure and services supported by other Faculties. Resulting discussions reinforced the possibility of resourcing research computing staff in central units to serve as a connection point for overall support that can be aggregated across domains to help balance and way-find for researchers with cross faculty requirements (relationships or access to infrastructure and services). It is important to note that this position did not change the notion that with some central provision, local groups still are in the best position for research support.

An example where aggregated effort and extension of local research support was highlighted was in the area of data management, especially with respect to secure data management. It was noted that having each research team or researcher having to navigate or understand the implications of compliance with the myriad of regulatory requirements around protected data (e.g. health data) put considerable burden on the researcher and introduced risk for the University.

This discussion around protecting data surfaced concern about a general lack of awareness on the issues of information security and especially the threats associated with nation states. Comments that suggested everything is fine, and that IST has the situation in hand demonstrated that some researchers are not aware of their role in information security leading us to conclude that more work needs to be done on this topic.

Recommendations related to research:

1. In order to manage institutional reputation, protect intellectual property, and ensure compliance with the appropriate safeguarding of data, we suggest an increased awareness campaign be undertaken to more fully understand the increasing threat related to information security, including that from nation states.

2. Consistent with current discussions on campus, continue to plan for research computing resources and liaisons to be available in a central support unit (whether IST or VPR area).
3. Explore what is happening at UBC and the University of Toronto in the area of research support involving the enterprise IT units. At the University of Toronto, a new group has been put in place called CRIS (Centre for Research Innovation Services). This is a partnership between Research Services, the Library and IT. The unit acts as a 'one stop shop' for various existing services that are available to researchers, but possibly unknown. In addition, based on requests from the research community the unit identifies gaps and assists the institution in prioritizing investments in research support.

Teaching

We were excited to meet with a group of lecturers and teaching fellows. There was clear passion from this group and a strong desire to improve IT support. The challenge was that most of our time was spent on technical issues that need to be resolved, rather than discussions of opportunities to advance teaching with the use of technology. Issues that received a lot of attention included:

- The design of classrooms, and most notably the common placement of screens and whiteboards (mentioned in many meetings), podium placement, lighting, access to podium equipment;
- September chaos that extends for weeks (missing cables, laptops can't connect, clicker issues, podium keys);
- Lack of proactive communication to teachers when problems are known in advance.
- Feeling that there needed to be more involvement of teaching faculty in the design of spaces.

Additional issues that were discussed were related to the administrative tools that are used to support teaching, such as Crowdmark, Odyssey applications, etc. These tools were identified as important, developed locally, not consistently polished, or having inconsistent support methods. In some cases, the local units provide the support, in other cases the support is transferred centrally and in still other cases it is a hybrid model. Indeed, we heard that applications were purposefully promoted beyond the developing unit so that the Faculty could transfer the ongoing support centrally. In addition, at times, the units wanted to keep development while passing on support. All of this leads to difficulty in support and onboarding issues for new faculty.

Finally, other elements that we heard during the review is that the IST unit that supports this is a supportive planner, that there is a deficiency in operating or capital renewal funding, classroom inventory is limited, and classrooms for support of new pedagogical approaches (e.g. active learning) is limited.

Recommendations related to Teaching

1. Develop a long-term vision for the overall directions, maintenance, and evolution of classrooms.
2. Ensure funding to provide a higher level of service for faculty teaching, including preventative maintenance, proactive service, etc.

3. Ensure capacity for innovation and support for instructors' changing needs for diverse pedagogical approaches.
4. Evaluate building classroom capacity at the core that allows for taking classrooms offline for upgrades. Optimizing the use of all classroom spaces over more hours of the week is a readily available solution to maintain and even grow capacity.
5. Ensure that any classroom planning is holistically approached. Appropriate academic support areas cooperate in their work on classrooms, but there are gaps in information and in processes.

Information Security

Information security was a specific topic area and was not generally brought up in discussion by the University of Waterloo community. However, it is an area that is of critical importance. The impacts of information security breaches including reputational impacts, business continuity, financial impacts, community trust issues, loss of IP, research data integrity, or potential loss of funding are all well known for research intensive universities. However, although the impact of an incident is equivalent, it is important to note that the probability of impact is significantly higher in a distributed IT environment, especially if information security is not a top priority for action and management. It is our perspective that the University of Waterloo is at greater risk with the distributed environment, and the reasonably absent response we received on this issue.

The days of information security being the responsibility of the central IT unit have passed and responsibility is campus wide. Universities have been moving to an environment where the Chief Information Security Officer has accountability for information campus wide and each unit then identifies those with responsibility for each unit, work group or system. Collectively they define the policies, standards and guidelines that each unit must follow and many campuses are evolving to having those responsible having to report on their progress related to these directions.

As well as the continued escalation and sophistication of information security attacks, the move to an increased multi-vendor and distributed delivery of applications and services (whether on-campus or in the cloud) necessitates a more deliberate information security environment. Understanding the inventory of systems being used, including local applications, cloud providers and technology partners and then assessing them to understand and manage risks for information security and business reliability is essential to successfully manage IT and information security risks.

Recommendations for information security:

1. Ensure information security issues contribute to the discussion of roles and responsibilities for IT
2. Create a culture and community of information security. Identify someone from each of the Faculties to come together to identify areas of highest risk and actions to mitigate.
3. Consider a mandatory training program for information security for anyone who has privileged access to sensitive information or for anyone who holds regulated data.
4. Comprehensively move to identify and assess systems, providers and partners to understand how systems and information are being managed across and beyond campus.
5. After the high priority items are tackled with some consistency from a campus-wide perspective, conduct a formal external campus-wide risk assessment program.

Strategy and Planning

Although it may appear odd to conclude this report with a section on strategy and planning, we have done this with intent. We heard throughout the review, including from senior university leadership, that having an institutional IT strategic plan would be helpful. We recognize that there is a “Information Systems and Technology Strategic Plan” that identifies priorities and activity areas through 2020. Our recommendation would be that a new institution-wide IT plan be developed which would also cover many of the thorny elements of this report clarifying how IT is organized, governed, supported and delivered. It would also identify campus wide vision for IT, goals, priorities and activities to guide the IT community as they deliver their services to the University community.

In Closing

In conclusion, we sincerely appreciate the opportunity to engage with your community on this review. Participating in this with a University with such a strong international reputation as Waterloo was inspirational and impactful in our own learning and understanding of IT delivery in higher education. We truly appreciated the openness of the dialogue with the community. It goes without saying that the passion and expertise of your community is your greatest strength on top of a very strong IT foundation at Waterloo. We wish the best in your continued journey.

III. External Reviewer Biographies

Sean Reynolds

VP for Information Technology and Chief Information Officer, Northwestern University
<https://www.northwestern.edu/provost/about/bios/sean-reynolds.html>

Sean Reynolds is the Vice President for Information Technology and Chief Information Officer at Northwestern University. Reynolds provides leadership for the continued development of an innovative, robust, and secure information technology environment throughout the University. The primary responsibilities for his office encompass a wide variety of strategic technology issues: governance and policy, resource allocation, information technology protocols, and the Northwestern Information Technology organization. Northwestern Information Technology provides support for academic research and technology, delivery of IT infrastructure and services, information security systems and compliance, administrative systems, and client support services.

Reynolds represents the University's information technology interests by affiliating with several regional and national higher education organizations, including the Big Ten Academic Alliance Chief Information Officers (a group he chairs), Cisco Higher Education Advisory Group, InCommon (within Internet2), and Research University CIO Conclave. He also serves on the Board of Trustees at the Adler Planetarium in Chicago and as Vice Chair for the McGaw YMCA in Evanston, Illinois.

Prior to joining Northwestern, Reynolds spent 25 years in information technology roles in higher education. Most recently, he served as the Chief Information Officer for Queen's University in Kingston, Ontario, Canada. Reynolds holds a BA and MA in Economics from the University of Guelph, Ontario, Canada.

Bo Wandschneider

Chief Information Officer, University of Toronto
<https://cio.utoronto.ca/>

A respected IT veteran, Bo Wandschneider has spent 30 years in Higher Education Information Technology, first at the University of Guelph and more recently as CIO and Associate Vice Principal, Information Technology, at Queen's University. His early years included a decade in an academic unit where Bo was embedded in the research enterprise and actively engaged in teaching and learning. These experiences have allowed him to develop a deep appreciation and understanding of the needs of the academic community.

During his career, Bo has been through two institution-wide email migrations; introduced an Administrative Systems Steering Committee to oversee the prioritization of enterprise administrative projects; and developed an ITS Strategic Plan. He has led and developed several partnerships around research data management, discovery and analysis, including a lead role in the formation of the ODESI project through Scholars Portal. Bo also has experience reorganizing an ITS leadership team, starting what Bo refers to as a "cultural change process".

A truly collaborative leader, Bo is well known across Canada for the breadth and depth of his knowledge, his desire to build partnerships, and his openness and willingness to share information and expertise with colleagues and staff. A frequent presenter at various professional forums such as Educause and CANHEIT, Bo is known as a visionary thinker and an effective strategist.

IV. Compliance and Policy

The following is a summary of sample policies, procedures and other statements, both internal and external, that either guide or can obligate technology and related practitioners on campus.

Policy and Procedure

Breach - <https://uwaterloo.ca/secretariat/information-security-breach-response-procedure>

Information - <https://uwaterloo.ca/secretariat-general-counsel/node/540>

IT Purchases - <https://uwaterloo.ca/secretariat/procedures/procedure-1>

Network Security - <https://uwaterloo.ca/information-systems-technology/about/policies-standards-and-guidelines/campus-network/statement-security-waterloo-computing-network-and-resources>

Network Use - <https://uwaterloo.ca/information-systems-technology/about/policies-standards-and-guidelines/campus-network/guidelines-use-waterloo-computing-and-network-resources>

Procurement - <https://uwaterloo.ca/secretariat-general-counsel/node/85>

Statements on IT - <https://uwaterloo.ca/information-systems-technology/about/policies-standards-and-guidelines>

External Legislation or Requirements

AODA - <https://www.aoda.ca/>

BPS - <https://www.doingbusiness.mgs.gov.on.ca/mbs/psb/psb.nsf/EN/bps-procurementdirective>

CASL - <https://www.fightspam.gc.ca/eic/site/030.nsf/eng/home>

FIPPA - <https://www.ontario.ca/document/freedom-information-and-protection-privacy-manual>

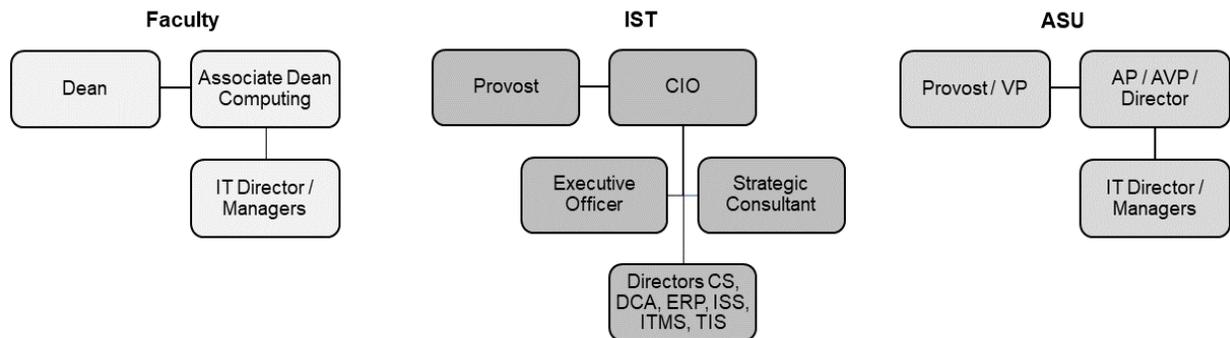
GDPR - <https://gdpr.eu/>

PCI - <https://www.pcisecuritystandards.org/>

V. Governance and Organization

Organizational Structures

The diagrams below for academic support groups and faculties represent 'typical' structures, though a number of different models may be present. For example, not all faculties have an ADC, but do have an individual designated as senior leader for IT who would participate on committees such as UCIST and have staff reporting to them.

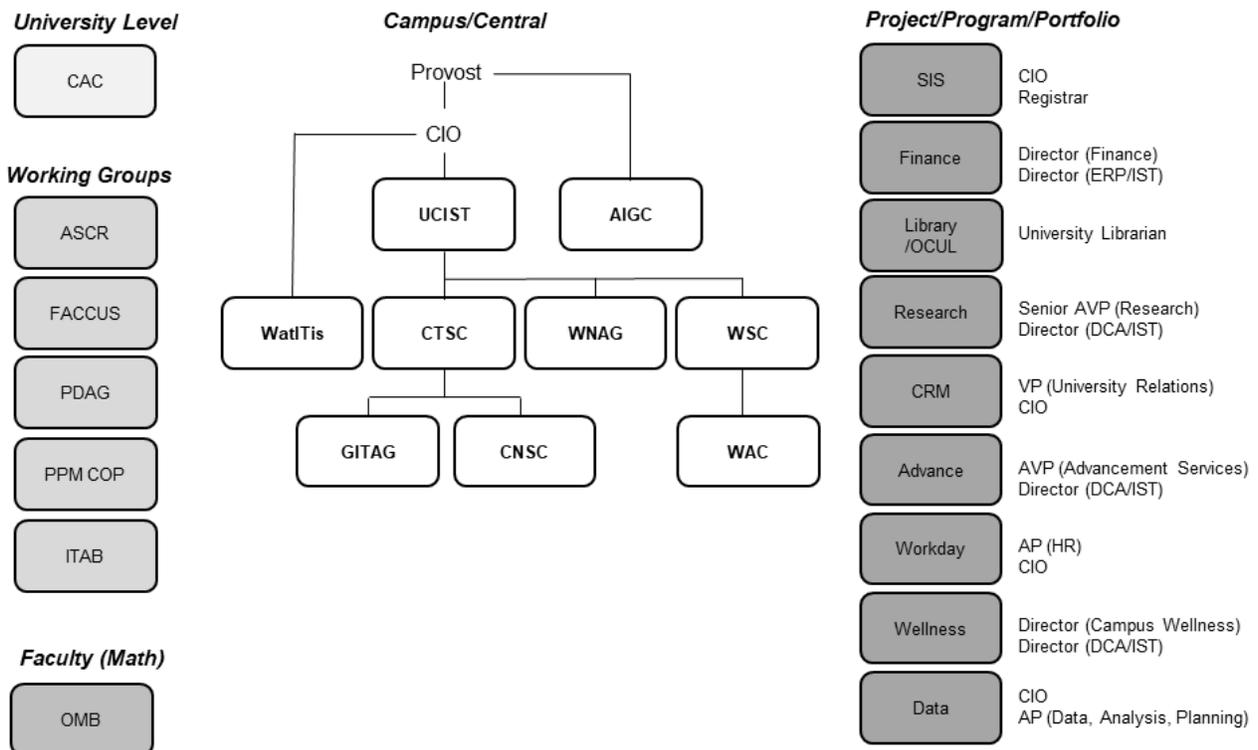


Campus Committees and Groups

This list and structure represent a sample of those groups with a significant IT component or relationship, but may not include all bodies with a technology aspect. It may not include more informal groups, where the campus has external affiliations (e.g., CUCCIO and its SIGs), research organizations, or vendor groups (e.g., HEUG) where Waterloo staff may have an active role. The level of activity for these groups may vary significantly.

- Advancement (Portfolio Steering)
- AIGC (Administrative Information Governance Committee)
- ASCR (Academic Support Computing Representatives)
- Campus Wellness (Project Steering)
- CAC (Copyright Advisory Committee)
- CNSC (Campus Network Services Committee)
- CRM (Project Steering)
- CTSC (Computing Technology and Services Committee)
- FACCUS (Faculty Computing User Support Group)
- FAST (Faculty Academic Software Team)
- Finance (Finance Systems Steering)
- GITAG (Green IT Advisory Group)
- HWIS (Health and Wellness Project Steering)
- ITAB (Student IT Advisory Board)
- Library (OCUL Alma Core Project Steering)
- OMB (OAT Online Advising Tools Management Board)
- PDAG (Professional Development Advisory Group)
- PPM/COP (Project and Portfolio Community of Practice)

- Research (Portfolio Steering)
- SIS (Student Information Systems Portfolio Steering)
- TUG (Waterloo, WLU, Guelph Tri-University Group)
- UCIST (University Committee for Information Systems and Technology)
- WAC (Web Advisory Committee)
- WatITis (Program and Logistics Committees)
- WSC (Web Steering Committee)
- WNAG (Waterloo Nexus Advisory Group)
- Workday (Project Steering)



Higher Education Examples

Northwestern

<https://www.it.northwestern.edu/bin/docs/it-gov-org-chart.pdf>

Simon Fraser University

<https://www.sfu.ca/itservices/strategy-and-policy/stewardship-model.html>

University of Alberta

<https://www.ualberta.ca/it-governance>

University of California, Berkeley

<https://technology.berkeley.edu/governance/model>

University of Manitoba
http://umanitoba.ca/computing/ist/pmo/media/U_of_M_IT_Governance.pdf

University of Michigan
<https://it.umich.edu/governance>

University of Victoria
<https://www.uvic.ca/systems/assets/docs/aboutus/guidetoitgovernance.pdf>

Western Carolina University
<https://www.wcu.edu/WebFiles/PDFs/WCU-IT-Governance-and-Prioritization-revised-August-1-2013.pdf>

Governance Related Resources

<https://library.educause.edu/topics/information-technology-management-and-leadership/it-governance>

<https://library.educause.edu/resources/2017/12/it-governance-toolkit>

<https://library.educause.edu/resources/2017/3/higher-education-it-governance-checklist>

<https://www.vantagetcg.com/why-is-it-governance-critical-for-higher-education/>

Other Groups

This list is not intended to be comprehensive, but a sample of specific UW IT committees and those which might have an impact on, interact with or support the overall IT function. Please note that not all committees or working groups maintain a public web presence.

Administrative Information
<https://uwaterloo.ca/secretariat/administrative-information-governance-committee>

Board Audit and Risk
<https://uwaterloo.ca/secretariat/audit-committee>

Computing Committees
<https://uwaterloo.ca/information-systems-technology/about/campus-computing-committees>

Copyright
<https://uwaterloo.ca/secretariat/committees-and-councils/copyright-advisory-committee>

PPM Community of Practice
<https://uwaterloo.ca/project-portfolio-management-community/>

Professional Development
<https://uwaterloo.ca/it-professional-development-advisory-group/>

VI. Services, Systems, Initiatives

Service Catalogues

AHS

<https://uwaterloo.ca/applied-health-sciences-computing/services>

Arts

<https://uwaterloo.ca/arts-computing/services>

Computer Science

<https://uwaterloo.ca/computer-science-computing-facility/services>

Environment

<https://uwaterloo.ca/environment-computing/services>

Engineering

<https://uwaterloo.ca/engineering-computing/about>

Math

<https://uwaterloo.ca/math-faculty-computing-facility/services>

Science

<https://uwaterloo.ca/science-computing/>

IST

<https://uwaterloo.ca/information-systems-technology/services>

Pandemic Learning Resources

Campus

<https://uwaterloo.ca/keep-learning/>

AHS

<https://uwaterloo.ca/applied-health-sciences-computing/faculty-staff-and-researchers>

Arts

<https://uwaterloo.ca/arts-computing/instructors>

Computer Science

<https://uwaterloo.ca/computer-science-computing-facility/getting-help/online-teaching>

Engineering Teaching

<https://uwaterloo.ca/engineering/teaching-and-learning>, and

Engineering Computing

<https://uwaterloo.ca/engineering-computing/video-conferencingteaching>

Environment

<https://uwaterloo.ca/environment-computing/remote-comps-and-thesis-defence>

Math

<https://uwaterloo.ca/math-faculty-computing-facility/online-teaching>

Science

<https://uwaterloo.ca/science-computing/science-computing-university-closurepandemic-plan>

Applications

In total, the campus manages well over 200 applications that might support administrative activities, special tools for teaching and learning, or for infrastructure. The following is a sample of those and shows the scope of support for these systems, which can range from large ERP to single user solutions. Please note that this does not include all systems and versions in all areas; common infrastructure software (e.g., databases) or desktop suites (e.g., Microsoft Office tools, browsers) are often supported at some level in many units.

AHS	Research/ Teaching	SAS, SPSS, R Studio, NVivo, Santos, Vicon, LabView, MATLAB, SigmaPlot, PowerLab, Vmax
	Administrative	Connect, SharePoint, WatIAM, MS Office, Skype
	Infrastructure	FileCloud, Adobe Connect, Jitsi Meet
Arts	Research/Teaching	7-Zip, Active Perl, Adobe (Acrobat, Flash Player, Photoshop, Reader, Master Collection, InDesign, Suite VIP), Audacity, Bloomberg, BlueGriffon, Celtx, Compressor, Corporate TaxPrep, DirectRT, Dropbox, Ebrary Reader, E-Prime, Evernote, FileZilla, Final Cut Pro, GAMS, GhostView, Ghostscript, Gretl, GTAPAgg7, HandBrake, HLM, iMovie, iPhoto, iTunes, KLite Codec Pack, LabView, Lego Mindstorms NXT, MatLab, MediaLab, MikTek, MPEG Streamclip, MTax, NicePlayer, Notepad++, Personal TaxPrep, Processing, Psychopy, Python, RStudio (with R), Rungtapp370, Shazam Pro, Shockwave player, SAS, SPSS, Stata IC, Tera Term Pro, TexMaker, TextWrangler, Thunderbird ESR, Twine, Unity, VLC Media Player, WinSCP, Write-N-Cite
	Administrative	Connect, SharePoint, WatIAM, MS Office, Skype, CALMS, Jira Service Desk, WebCheckOut, DeepFreeze, Teams, Arts-OFAS (Online Faculty Application System)
	Infrastructure	LabStats, CrashPlan, N:\ Drive (100Gb), SCCM, Scinage, WebEx
CSCF	All	Online Advisor Tools and Exam Management (Odyssey/EMS), Nextcloud (file share/sync), gitlab.cs
Engineering	Research/ Teaching	CAD/CAM, Finite Element Analysis, MATLAB
	Administrative	OFIS (Online Faculty Information), Dean's Appointment, Safety Tracking, PHD Defense

MFCF	Research/ Teaching	R, MATLAB, Python, Julia, Jupyter, RShiny, Watfactory, Mobius, R Studio, Maple, Sage, S-PLUS
	Administrative	Filemaker, Visibull, Scinage, OAT
	Infrastructure	Jamf, SCCM, Xhier, Salt, Nagios, Grafana
Science	Research	NMR Research Lab, CNC Software, WebRTC/Skype/Webex (Defenses, Qualifying Exams)
	Administrative	Evaluate (Course Evaluations), Markbox (Test Marking and Distribution), Safely (Safety Inspections), Scinage (Digital Signage), SciON (High School Contests), VIF (Illness Verification), Outline (Online Course Outlines), China 2+2, Cooperator, SciBase, UpGrad, ChemStores POS
IST / ASU	All	2FA Enrollment and Device Management Portal, AccessAbility Online, Accuro, Active Directory, AdAstra, ADFS, Adobe Connect, Agile Shipping, AI Chatbot, Aimetis, AIMS (EDC, ePark), Alarm Centre, Asset Bank, Auradata, Avanti, Bambora, Bonfire, Bongo, Budget Tool (Housing), CallPilot, Campus Incident, Campus Map, CAS, CentreSuite, CIBC, Cisco WebEx, ClinicConnect, Consigno Notarius (e-signatures), Clinic Information System, Cognos, Concur, Confluence, ISNetworld Contractor Compliance, Course Selection Offering List, Crestron (E-Classroom, Fusion), Cyon, D3 Police Information System, Data Centre, Data Protection Manager, Dejero, DNS blocklist, Document and Matter Management System (LIS and CMAHRO), Duo, DV Sports, E-classroom database, Elastic Search, Elastic Stack, EMC NetWorker, Endowment Refund, Campbrain (ESQ), Erwin EA Agile, Eventworx (Sabretooth), ExamProc, Exchange, FARECOMM, Fax Server Management, Campus Firewall, Food Safety (Warrior Grill), Food Services Operations, Fusion, GIT, Globalsign, GoSecure, GoSignMeUp, Grad Reference Forms, Grouper, GroupMail, HoME, Horizons (Waterloo Passport), iCIMS (recruiting), iClicker REEF, Identity Server, IM Leagues, iModules (advancement), Infoed, InfoSilem Enterprise, International Travel (Anvil Group), Inteum, IPAM, ISS-App, IST webstore, IST-Alert, Jenkins, JIRA, Key Management, Kual Coeus, LEADS, LEARN, Learn Tools, License server, Life Labs, Livestream, Logging System, LTM (Load/Traffic), LinkedIn Learning, Mailman, Mailservices, Master Data Server, Mattermost, MBAM, Medeo (virtual health), MS Azure Data (Factory, Bricks, Lake, Catalog), Ministry of Health (portal), MS PowerBI, Ministry of Advanced Education and Skills Development, Mobile Pay Skip Line, NAN Copyright, Networker, nfdump/nfcap, Nginx Gateway, ninfo (plus plugins), Off Campus Housing Listings, Office 365, Office Online Server, ONA, OnBase, OUAC), Ontario Work Study, Open Data API, Oracle

		User Productivity Kit, PaperSave, Parklane, PBX, PEAR, PebblePad ePortfolio, Penelope, PHP Live Chat, Podium Access (Fob), Policy 73, Portal, Power Control, Client, Presagia, Prime, PrintSrv, Proofpoint, Q-Flow (Qnomy), QRadar, Q-SYS Designer, Qualtrics, QualysGuard, Quest, Radius, RaisersEdge, Request Tracker, Research Signing Authorities, RezMail, Rhapsody, RPX, SARS, SC Logic, SCCM, Schedule of Classes (U/G), SCOM, SecretServer, SendIT, Seq, Sharepoint, Shibboleth, Shopify, SiriusXM, Skype for Business, socialbakers, SourceAPI, SQL Server Integration Services, StudentCare, Suricata, Switchboard, Tableau, TD, Telephone Billing, TFS, Third Mug, Titanium Scheduler, Tix Hub (UW Theatre), Tuition Benefit Application, Turnitin/PeerMark, Undergrad Calendar, Unit4, University Tickets, UniteFax, uPrint, UWat.ca, UWaterloo Scholar, VDI, Velocity, Visible, VPN, vRealize, vSphere, Watcard, Waterloo Photos, WaterlooWorks, WatIAM (IIQ), WatSafe, WatVote, WC Online, WCMS, Webreg (EventWorX), Western Union, Wireless, Workday, Wowza, Wrike, XAS, Xerox CentreWareWeb, Zeag (Gate Control), Zeek, Zello
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Projects

Projects and key initiatives are not maintained today in a single comprehensive list for campus, but the following is a compilation of some recently completed efforts or those underway at the time of the review. It is intended to demonstrate the nature and scope of activity across campus. It does not reflect operational or like activities. Projects noted under a given area may be specific to that constituency, or in many cases involve a wide range of stakeholders. Additional information on projects and supported software, is available at:

<https://uwaterloo.ca/information-systems-technology/about/projects>
<https://fast.uwaterloo.ca/>

AHS	HIPAA/PHIPA Server Space (to IST datacenter), Audio-Visual Refresh and New Installations, Server Co-location to IST Datacenter
CSCF	High-availability MySQL/PostgreSQL, Ceph cluster (distributed filesystem and S3 object store), Compute cluster reservation/management system
Engineering	Engineering Accreditation Data Collection, PHD Thesis Defense, Dean's Appointment System
Library	OCUL-CF Alma Implementation
MFCF	Central Storage Renewal, Course Selection, Online Public Courseware, Network Redesign (HP to Cisco)
Science	Research Storage (Sun to ZFS)
IST / ASU	Akindi, Budget Software Faculty of Math, Business Continuity, Campaign UW, Campbrain (ESQ), Campus Network Infrastructure Refresh, Constituent Relationship Management (DubHub), Contract Management System, Virtual

technology for Secretariat/President, Crowdmark Service Model, Data as a Strategic Resource Program, Decommission CAS, Desktop Rollover (DTR) Inventory Project (for Academic Support), Digital Video Storage & Delivery Services, Electronic Health Records, Email Routing and Audit, Email Security Evaluation, Emergency Desktop Notification Replacement, Equity Hub Software Investigation, Ethics Cloud System (Kuali) Reporting Enhancement, Function Point Implementation, Graduate Online Application System Acquisition, Graduate Recruitment Transformation Project, Identity Assurance Process Improvement, Mandatory 2-Factor, Instructor Access Controls (Grouper), International Relationship Management Selection, Investigate Contract Licenses, IST Applications Inventory (Phase 2), IST Internal Reporting, Java license, Jira PPM Implementation, Laptop Encryption, Legal Matter Management System Investigation, Mac Management, myResearch (Award Management and Funding Discovery), New Enterprise Xperience Transition Team (Housing), O365 (Program, Tenant Migration), ONA Tool Rewrite, OnBase Review, One Button Emergency Notification, OpenScholar / PURE Review, Oracle Cloud Proof of Concept, Parking Services Gate Software (expansion), President's Office CRM, Production Studio Move, QFlow Service Expansion (SSO), Quest Rapid Delivery Winter 2020, Red Hat Enterprise Linux (RHEL) Web Application Migrations, Service Level Agreement (SLA) Renewal, SIS Legacy Application Review and Migration, Software Defined Storage, SQL Server Quest (Oracle DB Enterprise license), Student Mobility RFP and Implementation, Suite CRM Service Development, The Centre Statistics, Travel Safety and Risk Mitigation, Tuition Calculation, WCMS 3.0 Rebuild
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VII. Select References and Resources

Canadian Centre for Cyber Security: Cyber Threat Bulletin, Impact of COVID-19 on Cyber Threat Activity (2020)

Deloitte Audits for Cyber Incident Response (2019), Campus Email (2019), Identity Management (2020), Disaster Recovery (2017), Project Management (2016)

Educause Horizon Report: Teaching and Learning Editions (2020)

Educause Top 10 IT Issues: The Drive to Digital Transformation Begins (2020)

Meeting the Educational Technology Challenge: Our Plans for Waterloo (2019)

OCAV Cybersecurity Briefing: OUCCIO (2020)

Report on the Review of Information Technology for Learning, Research, and Administration at the University of Waterloo (2009)

Report of the Information Technology Task Force – Waterloo (2003)

The Strategic Council: The Response to Covid-19 Waterloo Student and Applicant Survey (2020)

University of Waterloo Strategic Plan 2020-2025: Connecting Imagination with Impact (2020)

University of Waterloo Data as a Strategic Resource: Program Proposal (2019)

Universities Canada (Academica Group with COU): Canadian Students and Parents Opinion COVID-19 & the Fall of 2020 Survey (2020)

Waterloo Bridge to 2020: Leveraging Resources Issue Paper (2019)

VIII. Prior Recommendations

Recommendations - 2003 IT External Review

2003 IT External Review on Teaching, Learning, Admin and Research – David Barnard (Chair, University of Regina), John Mather (Manulife), Larry Symes (University of Regina)

1. The Provost should initiate a consultative process aimed at arriving at the development and common understanding of a statement on the University of Waterloo's commitment to the use of information technology as a strategic component of the University's next stage of development.
2. A significant additional budget allocation (at least \$1 million a year) for enhancing institutional priorities in the use of information technology should be made. The money should be provided centrally, and used to create incentives to induce units to cooperate with central initiatives.
3. Develop partnerships with private sector technology suppliers that would augment the available resources by \$3 – 5M annually, in support of applied technology programs but with spillover funding to administrative and research computing initiatives.
4. The University of Waterloo should continue its current policy of acquiring major enterprise software systems from commercial vendors where possible.
5. Information Systems and Technology should be renamed, perhaps as Information Services, with an explicit commitment to customer service in its mandate.
6. Information Services should be responsible for:
 - a. Developing and maintaining enterprise information systems,
 - b. Providing and supporting the networking infrastructure to the individual workspace unless otherwise explicitly negotiated with departments or faculties,
 - c. Ensuring that all faculty and staff members have computing resources, including software tools, necessary to fulfill their roles in achieving institutional goals and objectives,
 - d. Coordinating with the faculties the provision of technical support (both hardware and software) to users,
 - e. Providing a seamless help desk service (or at least the coordination of such a service with the faculties), and
 - f. Providing an information commons, possibly in collaboration with the library.
7. Faculty computing support groups should be responsible for:
 - a. Selecting and provision of hardware and software to support the teaching needs of the faculty
 - b. Supporting the specialized research needs of faculty members,
 - c. Collaborating with Information Services to provide technical support (both hardware and software) to users,
 - d. Collaborating with Information Services to provide a seamless help desk service.
8. Separate the role of Director of Information Services from that of Associate Provost for Information Technology. Let the Director report to the Associate Provost, and have

responsibility for managing the central organization. Give the Associate Provost a strong mandate to develop and achieve the strategic vision of the University of Waterloo with respect to leadership in the use of information technology.

9. Establish a University Committee on Information Technology Strategy and Policy. This should be chaired by the Associate Provost for Information Technology and have as members some deans, together with some directors of non-academic units and possibly student, faculty and staff representatives.
10. Have the Associate Vice-President, Learning Resources and Innovation report to the Associate Provost for Information Technology. Develop a shared vision with the deans of the role of the Centre for Learning and Teaching Through Technology and the pace with which its work will be integrated into the faculties.

Recommendations - 2009 IT Task Force

2009 IT Internal Task Force – Geoff McBoyle (Chair and Provost), Alan George (Associate Provost IST), Dennis Huber (VP Admin and Finance), Ken Coates (Dean of Arts), Tom Coleman (Dean of Math)

1. The provision and management of the technical infrastructure, namely Network Management; Email; Anti-virus and Windows Update Services; Blackberry Devices; Software Purchasing and Licensing; Web Content Management System; should become the responsibility of IST after consultation with the relevant local client group(s).
2. The University should consolidate, to the maximum extent possible, Active Directory forests and domains, with a preference to move to NEXUS, if feasible.
3. IST should ensure that: a) a higher level of staff deployment be made in the client service area; b) points of contact be clearly defined; c) the approval process within IST be streamlined wherever possible; and d) prior information be disseminated to affected parties of any impending changes.
4. The delivery of IT services by IST should be prioritized according to a hierarchy of needs to be determined by the Associate Provost, IST, in consultation with the relevant Director(s) within IST.
5. IST should be encouraged to organize follow-up seminars on innovations of potential application within the UW computing community.
6. Senior IT personnel should look favorably upon staff requests for secondments and for team projects.
7. A committee should be created, chaired by the Associate Provost, IST, and composed of a subset of Directors of IST, the Manager of IT Security, and heads of computing groups in Faculties, the Library and Housing and Residences for the purpose of ensuring the exchange of information on IT developments, both active and planned, in a timely and efficient manner. As a working title, the name Computing Technology and Services Committee (CTSC) is suggested.

8. The Computing Technology and Services Committee should have, as priority objectives:
 - a. the development of a compendium of IT expertise at UW;
 - b. the development of a 'library' of best practices in IT service solutions;
 - c. the formulation and/or promotion of team projects to develop innovative technologies and services.
 - d. The Computing Technology and Services Committee should have, as priority objectives:
 - e. the development of a set of preferred configurations of desktop equipment across campus;
 - f. the development of a strategy to encourage all faculty and staff to
 - g. adhere to the preferred configurations
 - h. have their computers managed so they remain up-to-date and so that it is convenient to update and install software in a timely and efficient manner.
9. The acquisition or development of new information technologies that have potential for campus-wide impact or use should be reviewed by CTSC and be subject to approval by the Associate Provost, IST.
10. The problem of unclear lines of authority should be addressed by the proposed Computing Technology and Services Committee, and its recommendations for clarification of responsibilities be forwarded to the Associate Provost, IST, for final decision.
11. The issues of non-compliance should be addressed by the proposed Computing Technology and Services Committee, and its recommendations to encourage better compliance be forwarded to the Associate Provost, IST, for final decision.
12. The directors/managers of IT units, through discussions at the CTSC, should address the issue of single points of failure in their unit to ensure that adequate backup expertise is available whenever possible, and as a minimum, require documentation of problem resolution be made in a timely and well organized fashion; and that it be made available to all appropriate IT staff.
13. A common request tracking system, such as the IST RT system, should be employed universally across campus.
14. Backup costs be should reviewed by CTSC to determine whether the fee schedule could be revised to improve utilization.
15. Local units should make: a) prior arrangements for IT service for new faculty and staff; and b) document procedures for ongoing assistance.
16. Faculties with linkages to satellite campuses should appoint a liaison person in both the home Faculty and the satellite campus IT staffs to ensure that satellite IT activities are both compatible with and leverage the wider University systems.
17. IST training sessions should be further developed to meet the evolving skills needs of IT personnel.

Statements and Directions - 2013 IT Strategic Plan

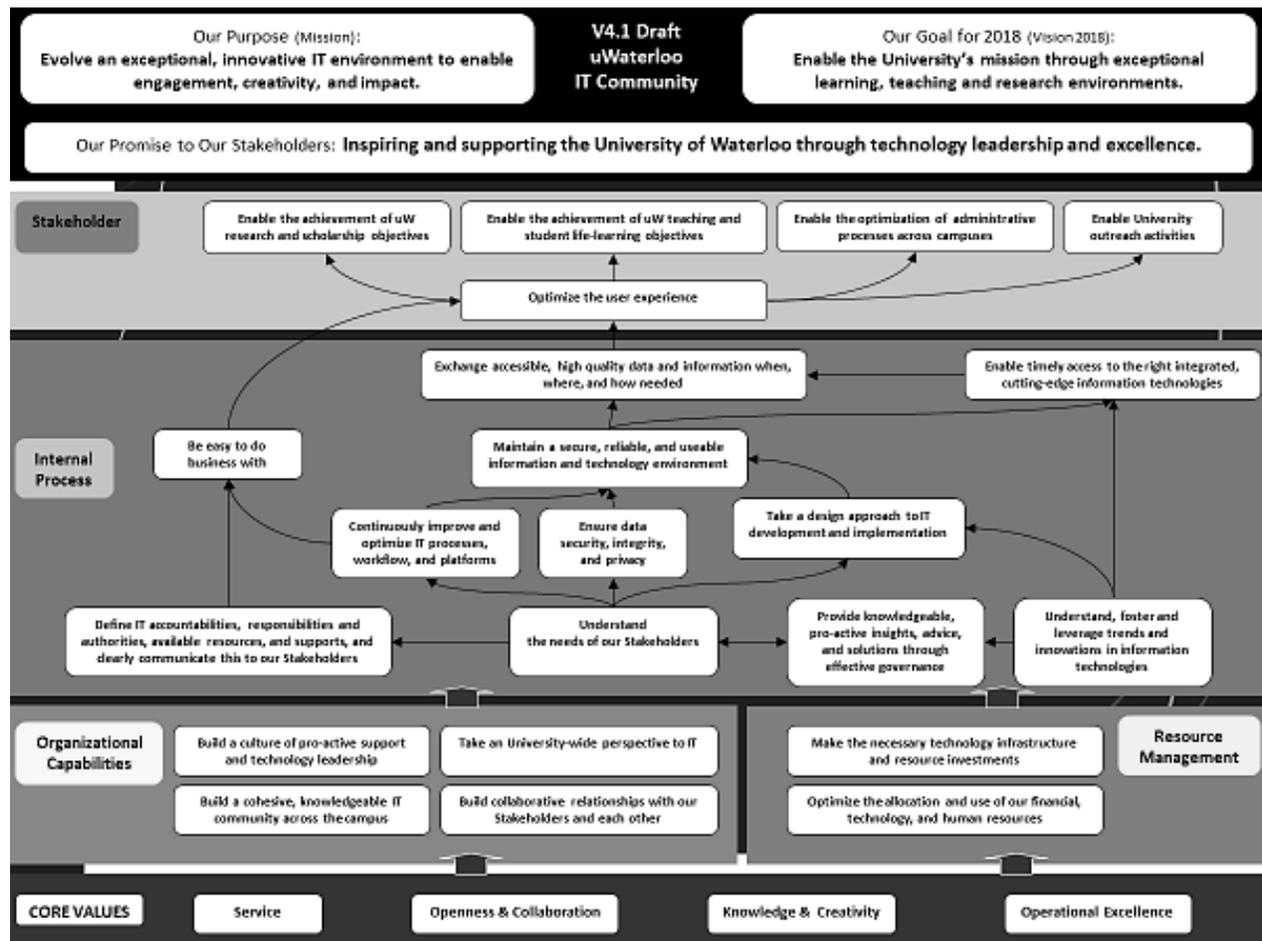
2013 IT Strategic Plan - Together We Enable (UCIST as Steering Committee)

IT Community Mission: Enable an exceptional, innovative, IT environment through engagement, creativity, and impact.

IT Vision for 2018: Enable the University's mission through exceptional learning, teaching and research environments

Promise to Our Users: Inspiring and supporting the University of Waterloo through technology leadership and excellence.

Strategy Map



Key Themes

1. Enabling Research – common services, local specialty support
2. Supporting Student-Life – services, support to student use of technologies in life and study, environment for expanding learning
3. Enabling the Learning Environment – IT services and support for technologies in their application to the learning environment
4. Information Management – access to information to facilitate use of data, while maintaining security and privacy
5. Governance – transparent, effective, participatory decisions
6. Supporting Business Processes – support admin functions by providing effective, efficient, and user-friendly applications
7. Re-focusing Client Service – focus our decisions, support, and evolution of technologies in collaboration with our users
8. Campus Integrations – enable collaboration in IT support and development in our design and architecture; federated IT

IT Community Directions

IT must facilitate efficient and effective University processes, respect choice in a diverse and innovative environment, and demonstrate leadership in strategic areas. With this balance in mind, we have identified key areas of focus in this first collaborative strategic plan.

- a. Revitalize our student IT environment
- b. Grow our technology-enabled learning environment
- c. Build upon information and technology foundations to
- d. Support research and administration
- e. Work together to improve usability, delivery and support of IT

IX. Glossary

ADKAR – Change Management Model (Prosci)
AFIW – Affiliated and Federated Institutions of Waterloo
AODA – Accessibility for Ontarians Disability Act
ASU – Academic Support Unit
BA – Business Analyst/Analysis
BCP – Business Continuity Plan
BIA – Business Impact Analysis
BPM – Business Process Management
BPS – Broader Public Sector Guidelines (Procurement)
CASL – Canadian Anti-Spam Legislation
CFI/IOF – Canada Foundation for Innovation / Infrastructure Operating Fund
CIO – Chief Information Officer
COBIT – Control Objectives for Information and Related Technology
COP – Community of Practice
COU – Council of Ontario Universities
CRM – Customer Relationship Management
CUCCIO – Canadian University Council of CIOs
DCA – Departmental and Campus Applications (IST)
DIA – Data Integration and Analytics (IST)
DR – Disaster Recovery
DRI – Digital Research Infrastructure (CANARIE)
DSR – Data as a Strategic Resource Program
DTR – Desktop Rollover Program
ERP – Enterprise Resource Planning (e.g., Finance, HR)
GDPR – General Data Protection Regulation (European Union)
HEUG – PeopleSoft/Oracle Higher Education User Group
HIPAA - Health Insurance Portability and Accountability Act (U.S.)
ICPC – Integrated Co-ordination and Planning Committee
IP – Intellectual Property
ITPD – Information Technology Professional Development
LMS – Learning Management System
MYAP – Multi-Year Accessibility Plan
OAT – Online Advising Tools

OCUL CF – Ontario Council of University Libraries Collaborative Futures
PaaS – Platform as a Service
PCI/DSS – Payment Card Industry Data Security Standards
PHIPA - Personal Health Information Protection Act
PMO – Project Management Office
RACE – Recognize, Assess, Control, Evaluate (Risk)
RFP – Request for Proposal (also RFI and RFQ for Information and Quote)
SaaS – Software as a Service
SEW – Skills for the Electronic Workplace
SMA – Strategic Mandate Agreement
TCO – Total Cost of Ownership
TUG – Tri-University Group of Libraries (Waterloo, Laurier, Guelph)
VPN – Virtual Private Network
WCAG – Web Content Accessibility Guidelines
WCMS – Web Content Management System
WFH – Work from Home
2FA – Two Factor Authentication
5G – Fifth Generation Wireless Technology