Project Planning Report for the Microsatellite Science and Technology Centre

DRAFT 2

Campus and Facilities Planning

December 16, 2009

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I. EXECUTIVE SUMMARY

The Space Flight Laboratory (SFL) at University of Toronto Institute for Aerospace Studies (UTIAS) is a unique university lab in Canada and an international leader in nanosatellite and microsatellite development. At present, the lack of sufficient physical space combined with the absence of a dedicated Canadian program to cultivate new opportunities or provide a network hub among internationally-recognized researchers is limiting the possibility for the successful UTIAS SFL program to advance its satellite research and technology development.

In September, 2009, the Space Flight Laboratory was awarded a Canada Foundation for Innovation (CFI)/Ontario Research Fund (ORF) grant to fund the construction of a new Microsatellite Science and Technology Centre (MSTC). The MSTC will provide an ideal opportunity to alleviate the current lack of infrastructure by creating a new facility at UTIAS that will accommodate and build upon the strengths of the current activities of the Space Flight Laboratory. The MSTC will encompass the existing Space Flight Laboratory work and use the new research space to aid the principal users to design, prototype, and test new nano and microsatellites devices for space.

The research, assembly and testing facilities of the Centre will be accommodated by constructing approximately 1,115 NASM of additional assignable space (~1,300 GSM). This building will be connected to the existing UTIAS facility at Downsview. The new building will house research and analysis areas, laboratories, a clean room, vacuum chambers, vibration facilities, an anechoic chamber and all associated equipment and support spaces. The Centre is expected to accommodate a complement of 5 to 10 visiting researchers at a time, up to 20 full-time staff and up to 25 graduate students.

A key positive secondary effect of the new MSTC is the space made available within the existing UTIAS facility, through relocation of existing SFL occupants. This project will free up approximately 418 NASM of area for use by UTIAS. A broader space planning study is currently underway that will help inform how to best re-use this space.

The architect and consultant selection process for the building will begin immediately following project approval, with an anticipated construction start in 2010 and occupancy in March 2011. These projected dates comply with CFI schedule requirements.

Based upon $53.67/GSM for UTIAS, the operating cost for the MSTC would be $77,770 per annum. This would include all costs excluding utilities such as building fabric, mechanical and electrical maintenance, caretaking, fire prevention and security. It does not include costs associated with maintenance of research components such as HEPA filter changes in the clean room, which will be funded through the research grants.

Funding sources for the entirety of the construction of the project are provided from the CFI/ORF grant award.

The estimated Total Project Cost for the construction portion of the project is $5,400,000.

II. PROJECT BACKGROUND

a. Membership

David Zingg (Chair), Professor, Director, UTIAS
Robert Zee, Professor, Manager of Space Flight Laboratory at UTIAS
Steve Miszuk, Director, Planning and Infrastructure, Faculty of Applied Science & Engineering
Julian Binks, Director, Planning & Estimating, Capital Projects Planning, Real Estate Operations
Mark Dwyer, Graduate student, UTIAS
Mohamed Elnabelsya 'alternate', Graduate Student, President Aerospace Student's Association
Omer Gulder, Professor, UTIAS
Freddy Pranajaya, SFL Staff Member, UTIAS
Ron Swail, Assistant Vice-President, Facilities & Services
Jeff Cook, Building Manager, UTIAS
Alan Webb (Secretary), Planning Officer, Campus & Facilities Planning

b. Terms of Reference

1. Make recommendations for a detailed space program and functional layout to accommodate the proposed new Centre for Microsatellite Science and Technology Development and Low-Cost Space Research.

2. Demonstrate that the proposed space program will take into account the Council of Ontario Universities' (COU) space standards and University's own best practice guidelines for research space.

3. Determine the secondary effects of the project, including any necessary space reallocation, and the impact on the delivery of academic programs and activities at the UTIAS site during construction.

4. Review the capacity of existing site services and infrastructure at the UTIAS site and determine the extent of upgrades, if required.

5. Identify all existing equipment and moveable furnishings to be relocated and reused, and new equipment and moveable furnishings necessary to the project and their related costs.

6. Identify all data and communications requirements and their related costs.

7. Identify a phasing plan and implementation plan for the project, if required.

8. Identify all security and occupational health and safety requirements and their related costs.

9. Determine a total project cost (TPC) estimate for the capital project, including costs associated with secondary effects.

10. Identify all sources of funding for the capital project and increased operating costs once the project is complete.

11. Report by January, 2010.

c. Background Information

This project is a result of a CFI/ORF award that was announced in September 2009 and is not based on previous approvals. It seeks to create a new Microsatellite Science and Technology Centre (MSTC) that will become a networking hub for space science and technology researchers, will have adequate physical area and facilities for developing new miniature satellite technology, and will bring new nanosatellite and microsatellite space mission concepts to sufficient maturity for implementation. The Space Flight Laboratory at the University of Toronto Institute for Aerospace Studies (UTIAS/SFL) is an international leader in nanosatellite and microsatellite missions (satellites under 10kg and 100kg respectively).

At present, there is a lack of sufficient physical space and of a dedicated Canadian program to both cultivate new opportunities (new mission, payload, technology ideas), and to act as a network hub among internationally recognized researchers. The current space limits the possibility for the already highly successful UTIAS/SFL program to evolve and advance the state-of-the-art in satellite research and technology development. This proposal provides an ideal opportunity to alleviate the problem by creating a new Centre, which will strengthen UTIAS/SFL's ability to conduct research and permit the evolution of its current activity.

Key dates include the submission of CFI award finalization documents by March 2010; start of construction as early as June 2010, but no later than December 2010; completion of the building as early as March 2011, but no later than December 2011; and installation of the necessary equipment as early as August 2011, but no later than March 2012.

d. Statement of Academic Plan

There are no additional academic needs for the Microsatellite Science and Technology Centre (MSTC). The Principal Investigator, his current complement of 16 research associates and 15 students will move to the MSTC once it has been constructed. These individuals will provide the human capital needed for the MSTC to fulfill its research mission. The MSTC has been sized to accommodate the natural growth of the program over the course of approximately 5-10 years.

e. Space Requirements

Overview of Existing Space

The existing space occupied by the Space Flight Laboratory will be vacated once the MSTC is opened. This includes Rooms 187, 188, 194, 195 and 137A at the UTIAS facility. The total amount of space currently occupied by SFL is approximately 418 NASM. Rooms 187, 188 are offices. Rooms 194, 195 are lab areas. Room 137A is best categorized as student research space.

A planning study is underway to assess the overall space needs for UTIAS. The results of this study will clarify how the UTIAS and MSTC areas compare to COU guidelines, and how best to utilize this vacated area.

In addition to the existing facility, the SFL has ground station antennas in the vicinity of its lab. There is a free standing tower at that south-east corner of the building that is used for MOST communications and nanosatellite downlink reception. There is also a roof mounted tower for nanosatellite uplink communications just above the Staff Lounge and Cafeteria areas. SFL would prefer not to move these antenna installations for the following reasons:

(a) These installations have undergone formal approval processes both at UT and through Industry Canada – Earth station antennas must be coordinated at a national level and a license must be issued for the specific geographic coordinates. Moving these antennas will introduce downtime, and the delays to satellite operation would not be acceptable. In addition, there is a risk that Industry Canada may deny the licenses necessary for new antenna locations.

(b) These antennas are operating with a specific ground station elevation mask that ensures a certain amount of coverage or contact with the satellites under operation. Changing their location may affect the total contact time available and impact the ability to conduct successful operations.

In regard to the existing antennas systems, the ground station connected to the antennas should be close by to ensure that cable losses are kept to a minimum (running long cables is not only unwieldy and impractical, but may render the antennas useless by virtue of high cable loss). SFL requests that UTIAS Room 193 (55.7 NASM) be assigned for the purpose of housing the SFL ground station (note that this is not covered in the MSTC proposal to CFI/ORF – there is no space allocated for a ground station). The room will require secure access. Room 193 would be used by students and research associates to operate SFL satellites, and to conduct research into ground control and mission operations.

The Existing Space Inventory in Appendix 1 provides a more detailed space summary including existing building floor plans.

Occupant Profile

The Principal Investigator (Dr. R. E. Zee), 16 research associates, and up to 15 graduate students will move to the MSTC. The MSTC will accommodate the current activities of SFL, including the design, development, implementation and operation of nanosatellite and microsatellite missions. Future activities will reflect an evolution of current activities toward the research and development of new, or immature technologies and new mission concepts. This activity will also include highly experimental nanosatellite or microsatellite missions in order to conduct research in space.

It is anticipated that the number of research associates and graduate students will grow with time, adding 5 research associates, 2 non-academic staff, and 10 graduate students within 5 to10 years, and that this growth will be accommodated by the MSTC. The MSTC is also sized to accommodate large equipment that SFL does not currently have, and for which SFL must currently use external facilities. The MSTC will also accommodate visiting professors (principal users) from other departments or universities, and their students, as necessary to fulfill the academic collaborative mission of the Centre.

A profile of the Space Flight Laboratory group that will move to the new Microsatellite Science and Technology Centre with overall UTIAS profile:

University of Toronto Institute for Aerospace Studies	**All of UTIAS 2008/9**	**SFL/MSTC Group (within UTIAS)**
FTE Academics	15.0	1.0
FTE Other Academic (Research Associates, PDFs)	23.6	16.0
FTE Professors Emeriti, active	2.1	0.0
Visiting Researchers		
FTE Clinical and teaching support staff	0.0	0.0
FTE Non-Academic Staff	7.6	0.0
FTE Graduate Students		
FTE Doctoral - PhD	58.0	1.0
FTE Masters- MSc Professional stream	71.0	12.0
FTE Masters- M.Eng Research stream	14.0	0.0
Total FTE Students	143.0	13.0

For general reference, a summary of the overall UTIAS space, the new MSTC, existing SFL area and the net increase to SFL/MSTC space:

UTIAS Category of Space	**Existing Area all of UTIAS (NASM)**	**Existing SFL Area in UTIAS (to be vacated)**	**New MSTC (NASM)**	**New total UTIAS Area (NASM)**
Teaching Labs & Support	153.3	0.0	0.0	153.3
Research Facilities	2,513.2	322.1	528.0	3,041.2
Faculty Offices & PdF offices	377.2	26.3	135.0	512.2
Graduate Student Spaces	681.7	69.3	275.0	956.7
Non-Academic Staff Offices	149.3	0.0	15.0	164.3
Departmental Support Space/Lounge	80.3	0.0	162.0	242.3
Library & Study	258.9	0.0	0.0	258.9
Subtotal- Dept COU Categories	**4,213.9**	**417.7**	**1,115.0**	**5,328.9**
Undergraduate Study Space	0.0	0.0	0.0	0.0
Student Club/Lounge Space	76.3	0.0	0.0	76.3
Subtotal- Add'l Dept Requirements	**76.3**	**0.0**	**0.0**	**76.3**
Total Nasm	**4,290.2**	**417.7**	**1,115.0**	**5,405.2**

The Existing Space Inventory in Appendix 1 provides additional information.

III. PROJECT DESCRIPTION

a. Vision Statement

The project seeks to create a new Microsatellite Science and Technology Centre (MSTC) that will become a networking hub for space science and technology researchers across Canada; will have adequate physical area and facilities for developing new miniature satellite technology; and will bring new nanosatellite and microsatellite space mission concepts to sufficient maturity for implementation. The Space Flight Laboratory (SFL) at the University of Toronto Institute for Aerospace Studies is an international leader in nanosatellite and microsatellite missions (satellites under 10kg and 100kg respectively).

At present, there is a lack of sufficient physical space and of a dedicated Canadian program to both cultivate new opportunities (new mission, payload, technology ideas), and to act as a network hub among internationally recognized researchers. The current space limits the possibility for the already highly successful UTIAS/SFL program to evolve and advance the state-of-the-art in satellite research and technology development. This proposal provides an ideal opportunity to alleviate the problem by creating a new Centre, which will strengthen UTIAS/SFL's ability to conduct research and permit the evolution of its current activity.

The MSTC will engage in early technology development and mission conceptualization. This will complement and provide an evolutionary path for current SFL activities that include the development of complete nanosatellite and microsatellite missions for in-situ space research. The new activities at the MSTC will complement current SFL activities and will harness the human capital of SFL to fulfill its mission. The move of SFL equipment and personnel to the MSTC is therefore essential to the fulfillment of the Centre's mission. The MSTC will also house new equipment that SFL does not currently possess, equipment that could only otherwise be accessed at external facilities at great expense and delay to research activities.

The MSTC will enable vigorous research into raising the Technology Readiness Level (TRL) by promising new technologies at levels 0 through 5, and by the completion of Phase 0 and Phase A feasibility studies essential in generating new mission concepts. This will synergize and leverage SFL's capabilities and expertise to promote technologies from TRL 6 through TRL 9, and implement experimental space missions from Phase B (Preliminary Design) to Phase E (Operations).

Currently, Canada shows great potential to collaborate in microspace missions, and yet we are lagging behind in our ability to do so. "Microspace" refers to an integrated, small-team approach to space missions that is beneficial since it can save up to 90% in costs and scheduling. The new Centre will strive to define and establish feasibility, and champion new technology development in support of new microspace missions to be implemented by SFL. The Centre will be the unifying force that will allow researchers and collaborators to boost Canadian activity in creating new microspace mission opportunities.

This initiative is multidisciplinary. Relevant scientific disciplines include geophysics, astronomy, atmospheric science, solar-terrestrial physics, and planetary science. Relevant technological disciplines include novel propulsion systems, high efficiency communication systems, next generation power systems, attitude control technologies, and high-performance computing technologies for space. In addition, payload technologies will be investigated with application to communications (e.g. broadband, Internet, search and rescue) and remote sensing (e.g. Earth observation for natural resource monitoring, safety and security, and national defence.) These payloads may be optical, RF (including SAR), thermal, or multi- or hyperspectral imagers.

The infrastructure requested in the project's CFI application consists of the following elements that will be located at the University of Toronto Institute for Aerospace Studies, where the Space Flight Laboratory currently operates: (i) a new building, (ii) assembly and test facilities, (iii) computing facilities and software, and (iv) lab furnishings.

The proposed Centre will build upon past CFI investments that have been made to the principal users. Most users, who are experts in related fields, have CFI-funded facilities of their own that will complement and synergize with the Centre. These users will develop instruments, devices, and parts that will contribute to next generation missions. The new Centre will take the outputs of the existing facilities and use the new infrastructure to aid the principal users to design, prototype, and test new devices for space, following the design approach used for nano/microsatellites. The Centre will allow study of the possibility for miniaturization or efficiency improvement; define mission concepts based on having achieved a minimum level of technology readiness; and propose and champion those missions for implementation.

The technologies that the new Centre will develop may include, but are not limited to:

(1) Instruments for nano/microsatellite missions – miniaturization of spectrometers, IR detectors, cryogenics, CMOS detectors, CCD detectors, lidar, multi-static radar, multispectral or hyperspectral imagers.

(2) Satellite technologies (platform technologies) – high efficiency solar cells, MEMS and high-temperature super conductor devices for radios, sensors and actuators, GPS-based positioning and formation flying strategies, new power systems, on-board computers, radios, attitude control hardware (sensors and actuators), deployment mechanisms, electric propulsion systems.

These new technologies are important to Canada because they enable:

(1) Canada to stay at the forefront of low-cost space missions, namely, nanosatellite and microsatellite missions on the international stage. This will give the country an advantage in executing its own small missions under national control with state-of-the-art capabilities. Canada would not have to outsource to another country, but could develop the satellites at home with capabilities that enable the most challenging missions in this class.

(2) Potential economic benefits through commercialization – technologies that can be sold at home and exported abroad.

(3) Greater scientific return to Canadian researchers for social benefit at home and internationally. They allow researchers to develop strong connections with the international science community by virtue of tangible space missions and real science return in the near term.

(4) Training of highly qualified personnel both in payload or instrument development and in the development of the satellites themselves. The Centre will create practical hands-on opportunities for students to develop or integrate new instruments and devices and be involved in conceiving missions. The activities of the Centre will also enable SFL to expand the number

of satellites under development thereby creating more opportunities for graduate students to receive practical hands-on training in satellite engineering.

b. Space Program and Functional Plan

In order to work on the mission conceptualization activities and early technology development projects for users of the Centre, it is expected that approximately 1,115 NASM of assignable space (~1,300 GSM including unassigned space) will be required with a full complement of test equipment and space qualification facilities. At the start of operation, the Centre is expected to house about 5 to 10 visiting researchers at a time (and their students), up to 17 full-time staff contributed from SFL to the Centre, and up to 15 graduate students.

To address this space need, CFI/ORF funds will be used to construct a new building. The building will be a research facility that is roughly divided into two main sections: a lab area and general work space. It is important to have sufficient visibility (windows) between the two areas for both presentation and also building-wide awareness of ongoing activities. Furthermore, windows to the outside will be important. There should be as much natural lighting as possible while adhering to security requirements.

The main assignable spaces are:

Laboratory Space

- Clean Room
- Thermal Vacuum
- Vibration Table
- Environmental Area
- Machining Area
- Research Lab – Dry
- Soldering & Assembly Area
- Analysis-Simulation – 11
- Shipping & Receiving

General Work Space

- Analysis-Simulation – 1
- Analysis-Simulation – 2
- Analysis-Simulation – 3
- Analysis-Simulation – 4
- Analysis-Simulation – 5
- Analysis-Simulation – 6
- Analysis-Simulation – 7
- Analysis-Simulation – 8
- Analysis-Simulation – 9
- Analysis-Simulation – 10
- Server Room
- Open Work Area
- Male & Female WCs (TBD, non-assignable)
- Mechanical/Building Services room (TBD, non-assignable)

Specialized equipment will be contained in the lab area. There will be special power requirements, venting requirements, plumbing for water and compressed air, and HVAC requirements to address increased heat load. Specialized equipment includes the following:

- Thermal vacuum facility - for testing the prototypes developed at the Centre in high vacuum conditions over temperature as expected in space. The facility must be large enough to support test equipment placed in the chamber.

- Optical test equipment - to evaluate the optical thermal properties of surface treatments used for thermal control. Important for devices with stringent thermal requirements, e.g. IR detectors, CCDs.

- Thermal sensors - to monitor temperatures during thermal testing of prototypes.

- Machining tools - to support mechanical assembly and rework of machined parts.

- Soldering stations - to assemble electronic boards (e.g. on-board computers, power electronics, radios, attitude actuators and sensors, instrument electronics).

- Clean room - to assemble optics and for final integration of flight prototypes that could potentially fly and for contamination control of sensitive devices. This will be a self-contained, semi-permanent sub-structure that is not dependent on building construction.

- Thermal chambers - to test prototypes under extreme thermal gradients and temperature conditions and also used also to test for workmanship.

- Power supplies and test equipment - to ensure uninterrupted power to experiments and tests that would otherwise have their results corrupted. If there are prototypes in the clean room, the room power would have to be maintained to avoid contamination. Battery analyzers will be used to test new battery technologies.

- Anechoic chambers - to test new RF devices and radio/microwave technologies in order to ensure valid RF measurements are being made that are not corrupted by environmental RF noise. Cleanliness may be required for sensitive devices or for flight preparation.

- RF/Microwave test equipment - to functionally test the performance of RF devices and new radios.

- Electronic work benches - to perform functional tests for newly developed electronics. This is essential to debugging and characterizing the performance of new electronics.

- Attitude control test equipment - to test and verify the performance of attitude sensors and actuators (e.g. sun sensors, star trackers, magnetometers, magnetorquers, reaction wheels), used for calibration and to determine mass properties of developed devices.

- Vacuum equipment - to degas adhesives or compounds used in the construction of new technologies in order to test venting strategies of prototype instruments or devices. It can also be used to test the effectiveness of hermetic seals.

- Vibration table - to evaluate ability to withstand launch loads and shock.

- Electrostatic discharge control - to protect electronics against damaging electrostatic discharge.

- Simulators - to provide simulated GPS signals to test GPS position determination techniques and atmospheric profiling approaches under investigation. A solar array simulator is needed to simulate I-V curves of representative solar cells for testing new power electronics or battery control.

The general work space is meant to be partitioned to provide a quiet work environment (noise from the main lab area will be mitigated). The general work space will include open and enclosed areas with the following equipment:

- Computer server, workstations and software - to model, analyze and simulate performance of mechanical systems (stresses, modal analysis), radios, antennas, attitude control systems, mission designs (orbits, contact analysis);to prepare drawings for machining, PCB fabrication, electronics board assembly. Compilers and debuggers will be used to program new devices.

- Analysis/Design work stations - lab furnishings (cabinets, tables, chairs, lighting) to support daily work and to store devices.

- Prototyping benches and general assembly, integration and test equipment and tools to support bread-boarding and early conceptual work.

The results of analysis, simulation and design, along with early breadboarding work conducted in the general work space will then be used in the main lab area to develop protoflight and flight technologies for incorporation in experimental space missions. The primary assembly, integration and testing of the technologies and their supporting spacecraft will occur in the main lab area. It is therefore important to have clear visibility and easy access between the main lab and the general work space.

A detailed space program (to be read in conjunction with the functional plans) is listed as follows: (see next page)

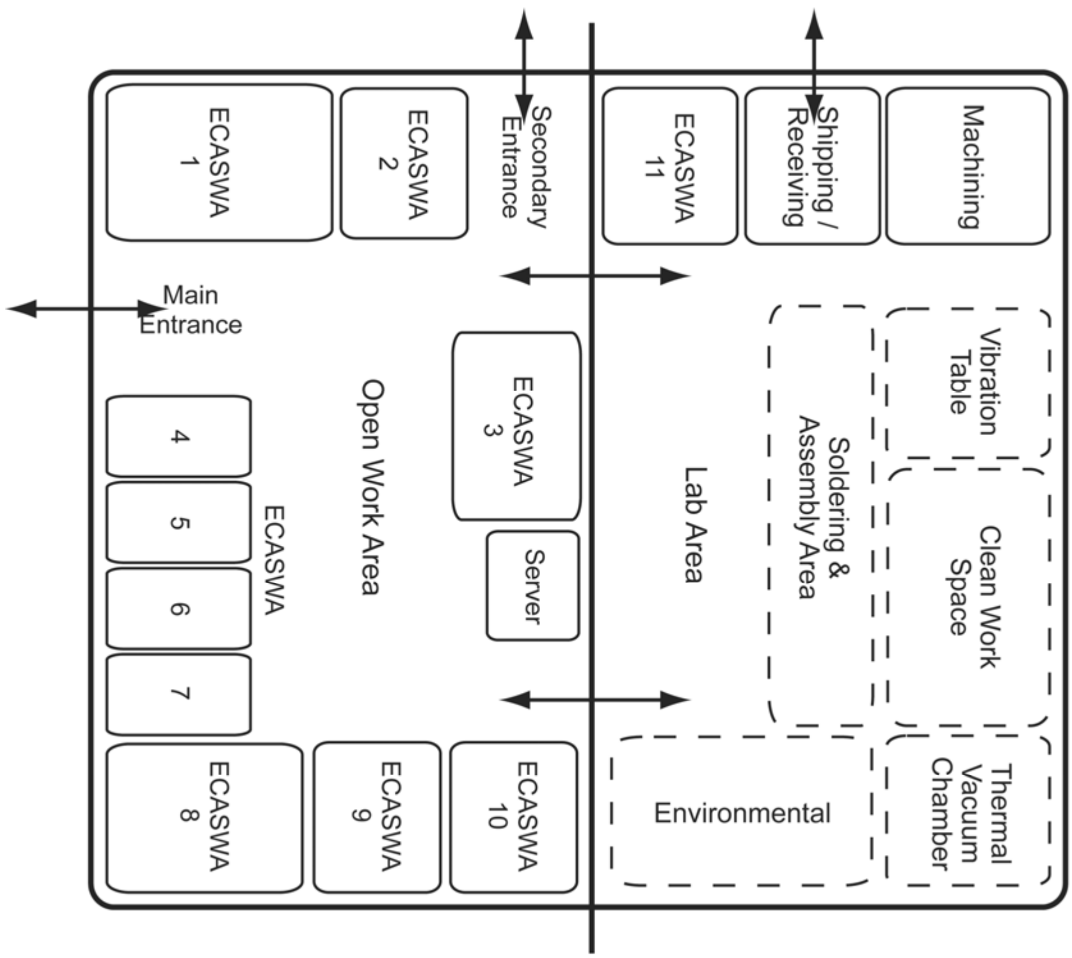
Space Program for Microsatellite Science & Technology Centre

Room Name	Use	NASM	Notes
Research & Analysis Area			
ECASWA 1	Boardroom	54.0	40 visitors
ECASWA 2	Meeting	24.0	10 visitors
ECASWA 3	Lunch/Staff Room	45.0	20 visitors
ECASWA 4	Office	15.0	2 residents
ECASWA 5	Office	15.0	2 residents
ECASWA 6	Office	15.0	2 residents
ECASWA 7	Office	15.0	2 residents
ECASWA 8	Manager's Office	35.0	1 residents
ECASWA 9	Office	27.5	4 residents
ECASWA 10	Office	27.5	4 residents
Open Work Area	Workstations	275.0	25 to 30 stations
Server Room		9.0	
		557.0	
Laboratory Area			
General Lab Area		190.0	up to 20 users
Environmental Area		60.0	up to 10 users
Thermal Vacuum Chamber		32.0	up to 4 users
Clean Room		74.0	up to 8 users
Soldering & Assembly Area		60.0	6 users
Vibration Table		32.0	up to 4 users
ECASWA 11	Storage	34.5	temp. workspace, up to 4 users
Shipping/Receiving		30.0	
Machining Room		45.5	up to 6 users
		558.0	
Total NASM		**1,115.0**	
Gross up 30%		334.5	
Total GSM		**1,449.5**	

Functional Plan

The key organizational aspect of the building plan is a general division into two distinct areas: the Analysis activities, which can be accommodated in a general office-style and open office environment; and the Laboratory activities, which can be accommodated in more industrial-style space. There should be a clear and secure separation between these two general building areas with views in between. The main building entrance should be on the Analysis side with the shipping doors on the Laboratory side. A secondary, secure entrance into UTIAS should be on the Analysis side. The analysis area (all ECASWA's) should have windows to the outside and be away from UTIAS shipping and receiving.

See Functional Layout diagram below for reference:



d. Building Considerations

The building requirements would be most economically accommodated by a one-storey structure. A clear height of 3m in the Analysis side of the building is required and a clear height of 4.27m is required on the Laboratory side.

The quality of finish of the building should be on par or exceed that of the most recent addition to the UTIAS facility, the room 133 extension.

The connection between the existing UTIAS facility and the new MSTC must be examined in detail in order to arrive at a design solution that meets the security needs of both areas and addresses pedestrian flow and loading requirements.

Placement of all fixtures, switches, receptacles (lights, duplex, etc.) should be considered in conjunction with maximum flexibility for furniture layout.

The Clean Room, Thermal Vacuum Chamber, and Vibration Table will be enclosed by purchased clean room envelope/partitions, therefore the actual building space for these areas need only be finished to the required specifications to receive the enclosures.

As noted in the Room Data Sheets, the Vibration Table area requires an 8” thick isolation floor beneath the vibration table.

Loose furniture and equipment is to be supplied by the SFL/MSTC. The loose furniture and equipment listed in the room data sheets is for design reference.

All relevant University of Toronto Design Standards (available through Facilities & Services and Capital Projects) must be applied.

<u>HVAC</u>

The building’s HVAC should be divided into systems: the Analysis area, and the general Laboratory area. Any special servicing for the Clean Room/Thermal Vacuum/Vibration Table area (class 10,000 clean rooms) will be provided via equipment.

<u>Natural light</u>

In addition to the comments regarding windows listed under ‘Security’, it is a requirement that each Analysis & Simulation room (ECASWA) have a window to the exterior, preferably with an operable pane. The inside face of these rooms should feature transom glazing and vision panels in doors or similar to allow natural light penetration into the Open Work Area.

<u>Data</u>

All network connections in the building must route back to the building’s server room which in turn is routed to the UTIAS facility and U of T data network ‘backbone’. Minimum Cat.6e cabling must be used throughout.

Accessibility

The MSTC must be a barrier-free facility as in accordance with building codes and the University's Design Standards pertaining to Barrier Free Accessibility.

Security

Building is to be equipped with a built in security system, monitoring all doors and windows. All external windows on the Analysis area side are to be equipped with glass break detectors and contact strikes for operable panes. General building access is by fob/card readers (with backup keyed locks). All external windows on the Laboratory side are to be equipped with security bars. In general, windows on this side of the building should be clerestory as there is a requirement for no views from the exterior into the lab area. Ideally the Centre would have a vestibule at its main entry, which would allow two levels of visitor screening (buzzer/intercom at exterior doors and escorted at interior doors).

Non-assignable

It is assumed that the design team will identify mechanical and electrical spaces required to make the building function.

A caretaking closet would not be required as long as the new building is connected to the existing building, and as long as it is a single storey building. If it is not connected, or if it has more than one floor, then a storage closet with a mop sink would be required on each floor.

Signage

All rooms should be equipped with signage and nameplate/room number on or near the door. The building itself must have general exterior signage as well as wayfinding for the main entrance and shipping entrance.

Sustainable Design

Although this building will not be pursuing LEED certification, every effort should be made during the design stage to design a building that will be energy efficient throughout its operating lifespan. The design should reference the City of Toronto Green Standard though will likely not be required to comply with the Standard if categorized as an addition rather than a stand-alone building.

Deferred Maintenance

Since the facility will be a new wing added to the existing building, no deferred renewal items need be included in this project.

A summary of asbestos-containing materials is attached presuming that there will be modifications made to the existing facility in order to connect the two buildings. During the design process more detailed information including floor plans can be provided.

e. Site Considerations

The project planning committee considered three different locations for the MSTC, including a stand-alone building as proposed in the original CFI application. In order to preserve future flexibility for redevelopment on the UTIAS site and maintain a direct connection to the existing UTIAS building, it was decided against locating the new structure on the open grounds and soccer field to the south. An addition or building to the rear (east) of the UTIAS facility was also ruled out due to cost implications of significant re-grading and additional fire route access.

The preferred site option is at the front (south-west) corner of the UTIAS facility. This location will allow direct access to the UTIAS facility while maintaining proximity to utility infrastructure along the south parking area. If unforeseen circumstances compromise either the construction budget or the net space that could be accommodated on this site, the committee may revisit the siting options.

There are several factors to bear in mind during the detailed design of the MSTC:

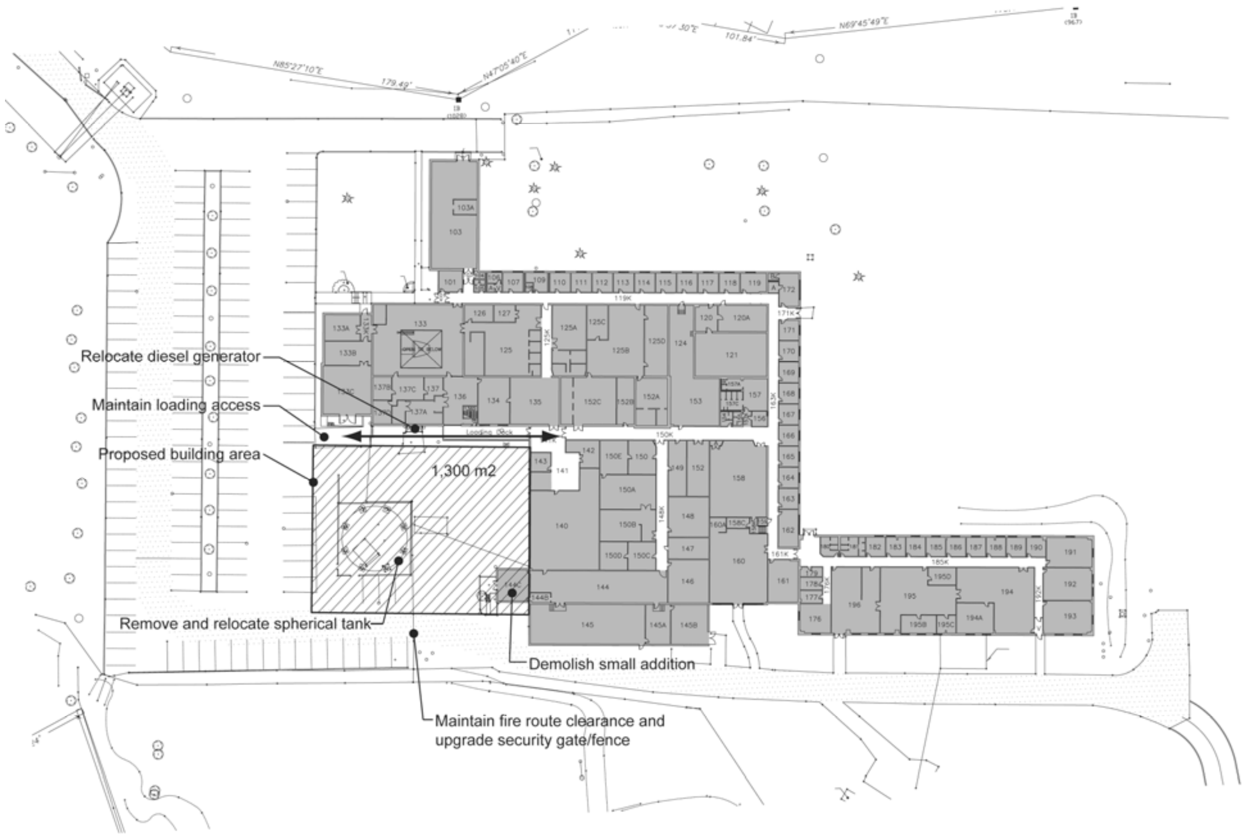
It is critical that the existing UTIAS shipping and receiving capabilities (adjacent to room 141K) remain following completion of the MSTC. This area could be incorporated into the MSTC loading access as well.

The existing fire route running along the southern edge of the UTIAS facility should not be disturbed and any existing means of egress from the facility should be maintained.

There is a grade change that must be negotiated from the west end of the proposed site location to the east end at the existing UTIAS facility.

While they are Toronto Regional Conservation Authority and provincial conservation measures that affect some areas of the UTIAS land (see Appendix), the proposed MSTC does not impact any of these zones.

The site diagram below shows an approximate location for the proposed MSTC with the existing UTIAS facility in grey (corridors shown in white):



f. Campus Infrastructure Considerations

Locating the building at the south-west corner of the UTIAS facility is the preferred location for the new space. It should be noted that a gas line, an 8" fire water line and an 8" water main are currently located in that area. Depending upon the final configuration of the building, some or all of these will have to be relocated.

There is sufficient electrical power capacity available for office occupancy and small labs (say, under 20kW of demand load). Assuming 5W per sf for electrical loads and 3W per sf for mechanical loads (i.e. HVAC), the total demand load is estimated to be 125kW. Any large equipment which has high consumption of electrical power must be identified for further load assessment.

It is assumed that the building will have its own heating, ventilation and air conditioning (HVAC) equipment that will not require connection to any other heating or cooling media within the existing building.

g. Secondary Effects

A key positive secondary effect of the new MSTC is the space made available within the existing UTIAS facility, through relocation of existing SFL occupants. This project will free up approximately 418 NASM of area for use by UTIAS (rooms 187, 188, 194, 195 and 137A). The UTIAS space committee will decide how to best repurpose this space to suit their needs.

By locating the MSTC at the south-west corner of the UTIAS facility, there will be several secondary effects to address:

- The small addition comprised of room 144C (33.8 NASM lab-related storage) and its exterior stair should be demolished. UTIAS must consider whether this room area needs to be made up elsewhere in the existing facility.
- The large sphere in the parking lot, a UTIAS emblem, must be removed and relocated. UTIAS to deal with and fund where the sphere will be finally located. This is an unused thermal vacuum chamber but UTIAS would like to keep it somewhere as a symbol for the facility.
- Several site service related components may need to be relocated (phone line box, etc.)
- Existing diesel generator and enclosure will likely have to be relocated given the loading requirements.
- If the new MSTC is located tight against the west wall of the existing UTIAS building, natural light access will be lost to rooms 143, 141 and 140. Room 140 is an unused machine room.
- The existing security fence must be reconfigured as part of the work.
- There are miscellaneous sheds and their contents that must be removed from the parking lot as part of the site's preparation.
- If the building is to be connected to the UTIAS facility, building code impacts re. occupancy, washrooms, egress, etc. must be thoroughly assessed during the design stage.
- Depending on the building's siting, up to nine parking spots (potentially more depending on building siting and fire route access) will be lost as part of the construction. Given that the site has in excess of 119 parking spots with overflow capacity on the east side of the facility, this should not be a problem.

In terms of staging, the new MSTC facility can be built while the SFL occupants remain in their current space and move in once the new building is completed. There will be temporary disruptions to parking and loading during constructions.

IV. RESOURCE IMPLICATIONS

a. Total Project Cost Estimate

The Total Project Cost, including all taxes, contingencies, secondary effects, permits and professional fees, landscaping and miscellaneous costs, but not including any furnishings or equipment, is estimated to be $5,400,000.

See Appendix 5 for Total Project Cost estimate.

b. Schedule

• Planning and Budget approval	January 18, 2010
• Business Board Approval	February 8, 2010
• Architect appointed	by end February, 2010
• Construction start	July 2010
• Occupancy	January 2011

c. Operating Costs

Utilities costs

This proposal anticipates that the new facility will be less energy intensive than the rest of UTIAS. The Bahen Centre was used as a peer building to arrive at $54,000 per annum as a representative figure for additional energy and water costs.

Operation and Maintenance costs

Based upon $53.67/GSM for UTIAS, the cost would be $77,770 per annum. This would include all costs excluding utilities such as building fabric, mechanical and electrical maintenance, caretaking, fire prevention and security. It does not include costs associated with maintenance of research components such as HEPA filter changes in the clean room, which will be funded through the research grants.

There will be an OTO start-up cost for the supply of recycling bins of $3,000.

d. Funding Sources and Cash Flow Analysis

Funding sources for the entirety of the $5,400,000 construction of the project are provided from the CFI/ORF grant award.

In line with CFI guidelines, there is no provision for interest charges in the TPC. Advance funds from the faculty will be provided to the project as needed to avoid interest charges.

V. RECOMMENDATIONS

THAT the Planning and Budget Committee recommend to the Academic Board:

(i) the Microsatellite Science and Technology Centre Project Planning Report be approved in principle,

(ii) the project scope as identified in the Project Planning Report be approved in principle at a Total Project Cost of $5,400,000 with funding as follows:

Canada Foundation for Innovation	$ 2,700,000
Ontario Research Fund	$ 2,700,000
Total	$ 5,400,000

Appendix 1 Existing Space Inventory

Existing Space Inventory for SFL group at UTIAS (2009)

Building	Flr	Room #	Department	Ctgy	Category	Prorate Type	Prorate %	Room Use Description	Stns	Square Metres
Aerospace	1	137 A	Aerospace	3.1	Research Lab			General lab work & research	6	41.54
Aerospace	1	194	Aerospace	3.1	Research Lab	Space	50	General research lab (Space Flight Lab)	4	69.21
Aerospace	1	194 A	Aerospace	3.1	Research Lab			General research lab (Space Flight Lab)	4	39.74
Aerospace	1	195	Aerospace	3.1	Research Lab			Space Flight Lab	0	120.06
Aerospace	1	195 B	Aerospace	3.2	Res Lab Support			Space Flight Lab	2	22.48
Aerospace	1	195 C	Aerospace	3.2	Res Lab Support			Space Flight Lab	3	11.97
Aerospace	1	195 D	Aerospace	3.2	Res Lab Support			Lab Workroom (Space Flight Lab)	0	17.15
										322.15
Aerospace	1	188	Aerospace	4.1	Academic Office			Faculty Office Single	1	13.10
Aerospace	1	194	Aerospace	4.3	Grad Stdnt Off	Space	50	Graduate Office Multi	6	69.21
Aerospace	1	187	Aerospace	4.4	Dept Supp Staff			Supp Admin Office (Space Flight Lab)	2	13.24
										95.55
										417.70

Appendix 2 Equipment / Furnishings Schedule (available on request)

Appendix 3 Room Specification Sheets (available on request)

Appendix 4 Total Project Cost Estimate

MSTC at UTIAS

Items	MSTC		
area	**1,300 GSM**		maximum.
Construction amount	$3,917,000	1	simple, attached, single storey building
Construction Contingency	$274,190		
Applicable HST	$142,920		
Total construction, including HST	**$4,334,110**		
Infrastructure Upgrades in Sector	$0		
Demolition	$0		incl in constr
Secondary effects	$103,410		demo & relocations to clear site
Permits & Insurance	$89,905		
Professional Fees	$704,945		Arch. + disburse + misc + PM
Computing Infrastructure	$0		equipment nic
Telephone set & install	$3,102		
Audio/Visual	$0		na
Moving	$0		nic
Staging	$0		nic
Furnishings	$0		nic
Equipment	$0		nic
Security & access systems	$0		included in constr
Signage: Interior & Exterior	$6,205		
Miscellaneous	$517		
Project Contingency	$157,806		
Finance Costs , allow	$0		fully funded throughout to avoid interest costs.
Total Project Cost Estimate	**$5,400,000**		

prepared jcb Dec 16 2009

Notes

1 Simple building on grade attached to existing UTIAS building at the SW. Includes exterior dock to connect with existing. Walls of precast or brick with punched windows. Flat roof. Building will have corridor connection to existing and will share electrical, fire safety, plumbing services & facilities to the extent possible. 2 package HVAC units provided for 2 primary zones - office & lab. Budget assumes that all services to site are adequate to support this addition.