FACULTY OF APPLIED SCIENCES

Academic Plan 2013-18

Updated October 2013
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1. Executive Summary

The Faculty of Applied Sciences (FAS) consists of the School of Computing Science (CS) and the School of Engineering Science (ES). FAS offers internationally recognized academic programs and conducts leading-edge research in a wide range of technology areas. Undergraduate programs are offered in Computing Science, Software Systems, Engineering Science and Mechatronic Systems Engineering. Both CS and ES offer MSc and PhD programs and ES offers an MEng program. The Faculty has nearly 2000 undergraduate students, over 400 graduate students and attracted $8.3M for research in 2010/11.

The Faculty plans to grow in selected areas during the next five years subject to availability of funding. The growth areas include new energy systems engineering and health informatics (in collaboration with Health Sciences) programs in Surrey, PFTE increases to the Mechatronics and Software Systems programs and new professional graduate programs. FAS currently runs an efficient operation, and several consolidation measures such as a centralized student service unit, transfer of engineering co-op to WIL and centralized budget management have taken place over the past three years. FAS requires substantial technical staff resources and equipment funding to support teaching laboratories.

The diagram below summarizes the objectives of the Faculty Academic Plan under the three engagement pillars of SFU’s vision.
2. Faculty Core Activities

The Faculty of Applied Sciences (FAS) comprises the School of Computing Science (CS) and the School of Engineering Science (ES). These two schools offer internationally recognized academic programs and conduct leading-edge research in a wide range of areas including the Science and Technology (S&T) priority areas of Canada (i.e., information and communication technologies, health and related life sciences and technologies, environmental science and technologies, natural resources and energy). FAS has activities in both Burnaby and Surrey campuses, while the School of Computing Science offers part-time studies through the Vancouver campus as well. Following is a summary of the core activities of FAS.

Undergraduate Programs:
CS offers major, honours, minor and certificate programs in Computing Science leading to a BSc or BA degree. A major in Software Systems (SoSy) was introduced at SFU Surrey in 2008. The School also offers joint major and honours programs with five departments. In addition, CS contributes to the Cognitive Science and Management and Systems Sciences programs. A BSc program (major and honours) in Geographic Information Science is offered jointly by CS and Department of Geography. The School offers a very successful dual degree program leading to BSc in Computing Science with Zhejiang University (ZJU) in China. This program was recently recognized by a provincial award for excellence in international education. A post-baccalaureate diploma in Computing Science is offered to students who already possess a university degree, and a certificate in Computing Studies is also offered.

ES offers BASc and BASc (Honors) programs in Engineering Science with options in Biomedical Engineering (with Department of Biomedical Physiology and Kinesiology), Computer Engineering, Electronics Engineering, Engineering Physics (with Department of Physics) and Systems. The above programs are fully accredited by the Canadian Engineering Accreditation Board (CEAB). In 2007, ES started a new undergraduate program in Mechatronics Systems Engineering (MSE) based in Surrey and the program received CEAB accreditation in 2011. A double-degree program in MSE and Business is also offered in Surrey. ES offers a minor in Computer and Electronics Design to non-engineering students.

FAS encourages students to participate in the co-operative education (co-op) option to gain valuable work experience, and co-op is mandatory for engineering undergraduate students. The co-op experience in engineering is closely integrated with the curriculum and professional skills development.

Graduate Programs:
CS offers MSc and PhD programs with research specialization in the areas of theoretical computing science; artificial intelligence; database systems and data mining;
computational biology; computer graphics and multimedia computing; networking; parallel and distributed computing; operating systems; programming languages and systems; computer vision; and medical imaging. PhD and MSc thesis students are provided with guaranteed financial support during their studies through various sources. The School also offers interdisciplinary graduate studies opportunities through the Graduate Diploma in Bioinformatics (partnered with Molecular Biology and Biochemistry) and through the Graduate Certificate program in Modeling of Complex Social Systems. The School started a dual-degree program at the graduate level with Zhejiang University in 2010.

ES offers MEng, MASc and PhD programs with specialization in communications; microelectronics; intelligent systems and control; biomedical engineering; energy systems and mechatronics. MEng is a course-based degree with a project that is normally directed to practicing engineers. Both MASc and PhD programs include a coursework component and a thesis. As in the case of CS, a majority of the graduate students in ES receive financial assistance from research grants and other sources.

Research:
There are clusters of excellence in algorithms and complexity theory, data mining, multimedia, visualization, communications, microelectronics, robotics, biomedical technologies, bioinformatics, intelligent systems/mechatronics and clean energy technologies. The annual research income of FAS for 2010/11 was $8.3M [$3.3M for CS and $5.0 M for ES] and this represents an increase of more than 30% from 2008/09. An increasing trend is noted in industry-oriented research and interdisciplinary research involving collaborations within and outside SFU. Over the past 3 years, FAS faculty members initiated new research projects worth over $20M. There are 4.5 Canada Research Chairs in the Faculty with one vacant Tier 2 Chair in MSE. In addition, ES has an endowed chair supported by Sierra Wireless and a search for another chair funded by industry is in progress. The Faculty recently concluded the search for the long-delayed LEEF Chair. Three faculty members in ES hold Michael Smith Foundation career awards and one CIHR career award. In addition, several FAS faculty members hold NSERC strategic and CHRP grants. One faculty member in CS received a Sloan Fellowship this year. There is a SIAM fellow and two IEEE fellows in FAS.

Specialized Services and Requirements:
The Faculty’s academic programs and research require substantial technical support and operating expenses for laboratories including computing infrastructure. Our specialized micro-fabrication facility is unique and offers the only credit course in micro-fabrication in BC. In addition, the teaching laboratories in ES and MSE require regular upgrading and technical support to meet accreditation standards. CS hosts the largest number of servers and workstations required for teaching and research of any academic unit on campus.
3. Planning Assumptions

This plan is based on the following assumptions:

- **Enrolment Plan:** The undergraduate and graduate PFTE targets specified by the university for FAS for 2012/13 are 2009 and 412 respectively. Our 2012/13 undergraduate PFTE target shows nearly 100% increase compared to the target for 2007/8. The Table below shows the enrolment plan for the planning period.

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<tr>
<td>UG PFTE</td>
<td>2009</td>
<td>2108</td>
<td>2191</td>
<td>2279</td>
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<tr>
<td>PG PFTE</td>
<td>412</td>
<td>429</td>
<td>446</td>
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- No provincial grant increase. Any salary increase with bargaining units will be funded through the central budget.

- Possibility of FTE expansion in Surrey.

4. Strategic Influences

4.1 Opportunities:

- **Demand for Computing Scientists and Engineers** – Recent studies done by the Province and North American organizations confirm the growing demand for computer scientists and engineers. It is reported that in areas such as clean energy, sustainability, large-scale data analysis, mobile computing, communication technology, biomedical technology, etc, the North American industry is heading towards a shortage of well-trained professionals. Proposed expansions in the Canadian energy sector, growth of digital economy and integration of IT in healthcare delivery provide substantial employment opportunities for engineers and computer scientists. BC has the second lowest post-secondary seats per capita in engineering amongst all Canadian provinces.

- **Surrey Expansion** – The Faculty can play a significant role in the expansion of Surrey Campus to support the growth of renewable energy, manufacturing, biomedical and IT industries in the South Fraser region. The proposed expansion of Surrey Campus also provides opportunities for FAS to develop programs in collaboration with FHS, FENV and BSB.

- **Professional Graduate Programs** – A very limited number of professional graduate programs in Computing Science and Engineering are offered by BC universities. A healthy demand for such programs exists from various industry sectors and new immigrants. FAS should exploit this opportunity to offer programs targeted to
selected industry sectors (e.g. Mechatronics, Software Systems, Product Design, Communication Engineering and Health Informatics).

- **Industrial Collaboration** – Our collaboration with industry and local agencies has increased in recent years. However, there are more opportunities to develop new collaborations and strengthen existing relationships. Industrial collaborations also expose students to practical problems and applied research while providing valuable directions in career planning.

- **Internationalization** – The Faculty has been a leader in international programs at SFU and offers the unique dual-degree programs in Computing Science with Zhejiang University. Both CS and ES undergraduate programs have a strong demand from foreign students and over 60% of our graduate students come from outside Canada. We currently have over 20% international students in undergraduate programs. Canada’s recent focus on Brazil and India provides rich opportunities to develop short-term student exchanges as well as sandwich degree programs. The Science Without Borders Program provides an attractive opportunity to work with Brazilian universities.

### 4.2 Threats:

- **Retention of Faculty** – This is a growing concern since the ICT sector is now offering attractive employment opportunities. There were six offers made to our faculty members in 2011/12 from other universities and we have had three resignations. SFU faculty salary structure requires changes to reflect the market realities in applied science disciplines and reward merit in a nationally competitive manner. The current system of retention awards/market differentials is not an effective long-term solution to address retention problems.

- **Competition for Undergraduate Students** – BC has created several new universities and a number of new engineering degree programs have started in recent years. The Faculty should be aware of the increasing competition for high-quality undergraduate students. Our recruitment strategy must be continually reviewed to attract high-quality students.

- **Competition for Graduate Students** – It is becoming increasingly difficult to recruit Canadian students or top-notch foreign students due to our inability to offer graduate financial support at the same level as other Canadian universities. Many Canadian universities and provinces have large funding programs to provide top-up funding or full fellowship support to highly qualified students. Another issue is our reliance on foreign students from a very small number of countries. This makes us vulnerable to international political developments and local economic conditions that might severely affect the supply of students. It is necessary to diversify our international graduate student pool to attract students from different parts of the world.

- **Program Accreditation** – The Mechatronics program has gone through its first accreditation review in 2011 and CEAB has identified several areas of concern (e.g., laboratory and research space, equipment funding, and low faculty complement). Burnaby Engineering programs are due for accreditation reviews in November 2012.
All engineering programs in Canada will be reviewed using new outcome-based accreditation criteria starting 2014. Accreditation of our programs is a continuing threat due to limited resources compared to regional and national peers.

5. Self Assessment

5.1 Strengths:

- **Quality of people** – FAS is fortunate to have an excellent group of faculty, students and staff. Five faculty members in Computing Science have received NSERC Discovery Accelerator Supplements over the past four years and another recently received a Sloan Fellowship. Three others are editors of leading international journals. Engineering faculty members have received several teaching excellence awards, fellowships from CIHR and MSFHR, and NSERC partnership grants with industry including several multi-million dollar grants from the NSERC-APC Program. We have high-quality students who receive numerous scholarships and honours and show strong commitment to international experience through participation in the DDP, Engineers Without Borders and international exchanges. Our students are also engaged in entrepreneurship programs and a number of them have received awards for entrepreneurship. Our staff are dedicated and hardworking and provide a friendly and supportive environment for students and faculty. Their contributions to the delivery of high-quality academic programs and research are commendable, especially under the current budgetary environment.

- **Experiential learning** – FAS is a leader in experiential learning at SFU. Our mandatory co-op program, capstone design projects and numerous team-based activities, including laboratories and projects in engineering, place us at the forefront of experiential learning and hands-on skills development. Computing Science also provides strong experiential learning opportunities through a non-mandatory co-op, capstone projects and the unique dual degree program with China. In addition, our students participate in many student competitions at the national and international levels and travel around the world to participate in academic exchanges, volunteer opportunities and co-op work.

- **Internationally renowned research clusters** – Our faculty members are world leaders in several research areas. In data mining, FAS is proud to have three of its faculty members amongst the 50 mostly highly cited researchers in the world and one amongst the top 5 in the world. Our research in bioinformatics and theoretical computing science are leading edge, with two of our researchers currently serving as chief editors of the world’s leading journals in these fields. Our research in biomedical research have been recognized by prestigious fellowships from CIHR and MSFHR, and our recent efforts to establish a BC Leadership Chair in medical technology will further strengthen our international profile in this area. Our research in sensor networks and nanomaterials has led to major breakthroughs and technology commercialization opportunities, while our researchers in communications engineering work closely with industry to increase Canada’s competitiveness. A
group of young faculty members has shown substantial leadership ability and success in clean energy research by attracting major funding from industry-government partnership programs. We are developing strengths in green computing with one of our researchers recently receiving a Sloan Fellowship to support her work. We intend to direct additional resources, when available, to the above research areas to build on our strengths.

- **Dual-degree program** – FAS is proud to have one of the most successful international programs in Canada that provides rich educational and cross-cultural experiences to Computing Science students from SFU and Zhejiang University. This successful program attracts very talented undergraduate and graduate students from China and SFU and includes intensive language training for Canadian students. DDP has recently received a provincial award for excellence.

- **Industry and other external collaborations** – FAS is a leader in industry collaborations at SFU. We have been a leader in attracting NSERC Engage grants and funding from NSERC partnership programs. We have a research chair funded by industry and funding is now in place for a second industrial research chair. Preliminary negotiations are underway to set up two additional research chairs. Our faculty members are actively involved in research commercialization and serve as consultants to industry. FAS is also an active partner with the City of Surrey and contributes to the economic development initiatives of Surrey.

### 5.2 Weaknesses:

- **Laboratory infrastructure** – Engineering undergraduate laboratories and Computing Science computer laboratories need substantial improvement. We have outdated equipment that often breaks down during classes and students constantly complain about the current state of our laboratories. Technical support for laboratories is also a major concern in both Engineering and Computing Science.

- **Space** – MSE program in Surrey has substantial space problems. The program is located in a building that is not suitable for engineering laboratories and research. Lack of fume hoods, certified space for biomedical research and very limited availability of space designed for heavy floor loads are causing considerable delays in research. The current situation is forcing researchers to forego additional research funding due to lack of quality research space.

- **Identity of software systems program** – This program at Surrey is threatened by competitive software-oriented specializations and concentrations at the Burnaby campus. While the Software Systems program was developed in response to the external review report of CS submitted in 2006, the School needs to support this program through a rationalization of its offerings at Burnaby. The current curriculum review in CS Burnaby provides an opportunity to address this problem.

- **Retention of undergraduates and graduate funding support** – This is an important issue that we need to deal with over the next few years. Our retention rates in Engineering are below the national average. Lack of attention to quality during the DTO expansion as well as limited enrolment management practices in the past have
contributed to this undesirable situation. The School of Engineering is already taking steps to address this weakness by undertaking a comprehensive curriculum revision, and FAS has improved enrolment management over the past three years. The graduate program in Engineering also needs improvement with respect to graduate student funding, availability of graduate courses and program regulations to provide students with a better experience.

6. Efficiencies

The following initiatives will be examined to create efficiencies.

- There is a need to examine workload equity across the Faculty. Computing Science has developed a set of guidelines that look into total faculty activity in terms of research, graduate supervision and service when assigning teaching. FAS will work with the schools to implement an equitable workload policy across the Faculty. The university budget model is based on activities, and FAS plans to gradually link school budgets to activities along the principles of university budget model to increase resource allocation equity and transparency.

- There is some duplication between the MSE program in Surrey and the Systems Engineering option in Burnaby. Some rationalization of courses and sharing of teaching resources between the two programs will improve availability of elective and graduate courses and increase student satisfaction.

- It has been recognized that the original structure of the biomedical option was unduly lengthy and complex. This has been addressed by the recently completed curriculum revision. However, the enrolment in the Biomedical Engineering option should be monitored to assess its long-term feasibility. Our teaching and research efforts in biomedical technology also require better coordination to improve course availability, research collaborations and overall visibility. The possibility of creating a biomedical technology institute at Surrey campus in collaboration with Faculty of Health Sciences, Fraser Health Authority and Surrey Memorial Hospital should be examined to increase the overall impact of teaching and research.

- Lack of graduate courses is a serious concern expressed by students. This concern can be partly addressed by more effective coordination of graduate courses between Surrey and Burnaby campuses and between schools. FAS will examine the teaching bandwidth of each school and provide direction at the Dean’s level to improve overall teaching efficiency.

7. Faculty Objectives

7.1 Engaging Students

- Implementation of learning outcomes – All engineering programs in FAS are required to meet the new outcome-based accreditation criteria by 2014. FAS plans to ensure that programs in Computing Science also define learning outcomes and implement relevant assessment procedures by 2016. These initiatives should help our
student recruitment efforts and allow students to make informed decisions on program options and elective courses. FAS currently collaborates with Teaching and Learning Centre (TLC) to utilize its expertise to implement learning outcomes.

- **Improve student retention** – The retention rates in Engineering programs are well below the national average, and we plan to make significant improvements in retention over the next five years. FAS has improved recruitment efforts and put in place an effective enrolment management plan. As a result, the cut-off average for admission has improved and the number of applications has increased. We plan to examine broad-based admissions to engineering and strengthen advising across the Faculty to improve retention. The recent re-design of the ES curriculum is expected to help.

- **Increase experiential learning opportunities** – FAS has the largest co-op program at SFU. Co-op can be used for preliminary benchmarking of learning outcomes. FAS plans to work closely with WIL to strengthen co-op education experience integration and utilize co-op in assessing selected program-level learning outcomes and increase the participation of Computing Science students. A new graduate co-op program will be developed in collaboration with WIL. In addition, we intend to improve our laboratory infrastructure and increase capstone and other projects, including semester-based programs, to strengthen experiential learning. A certificate in technological entrepreneurship will be introduced in collaboration with Beedie School of Business.

- **Improve graduate student experience** – FAS will introduce several measures to improve the quality of the graduate student experience. Efforts are currently underway to implement minimum funding guidelines for graduate students. In addition, graduate program committees will be asked to develop initiatives to strengthen the quality of supervision, increase availability of courses and introduce initiatives to strengthen professional skills development. A new graduate-level co-op program will be implemented in collaboration with WIL. We plan to continue to pursue an NSERC CREATE grant.

- **Strengthen teaching quality** – There is room to increase teaching excellence across the Faculty. FAS should encourage faculty members to introduce novel teaching pedagogies and implement best practices in undergraduate education. In this regard, FAS plans to establish a small committee at the Faculty level to identify a few initiatives that will strengthen teaching excellence. FAS could benefit from the introduction of a peer mentoring program for teaching to increase teaching excellence. We also plan to collaborate with TLC to assist faculty to implement best practices in teaching.

- **Improve laboratory infrastructure and technical support** – Our undergraduate programs are very lab-intensive and students gain valuable experience from lab classes. However, most of our laboratories have outdated and poorly functioning equipment. A plan will be developed to renew laboratory infrastructure over the next five years. We have invested over $700K over the last two years but we need approximately another $1M to completely modernize our laboratory infrastructure.
We also plan to increase technical support by directing any new funding or reallocation of current resources.

- **Increase diversity of student population and participation of women** – FAS has over 20% international students and a quite diverse student body. However, the bulk of our international students come from a very few countries. A more vibrant learning environment and an enhanced inter-cultural experience can be created by drawing students from different regions of the world. Female student enrolment in our programs is quite low. FAS Student Affairs Unit will be asked to strengthen its efforts to recruit female students and introduce initiatives to improve the quality of experience of female students in the Faculty. We aim to reach 20% female participation in our programs by 2018.

- **Support establishment of FAS Student Development Fund** – FAS students can gain very valuable experience and develop their professional skills through participation in various student competitions, student chapters of professional and technical societies, and international organizations such as Engineers Without Borders. Currently FAS students have very limited resources available to participate in various extracurricular activities. FAS is in discussion with our student groups to support their efforts to establish a student development fund that will be supported by annual contributions from students and advancement initiatives.

### 7.2 Engaging Research

- **Increase research excellence and impact** – FAS has built an international research reputation in a number of areas (e.g., data mining, bioinformatics, communication engineering, etc.). Our faculty members have strong citation records, serve as editors of major journals and receive prestigious research awards. More can be done to strengthen research excellence by pursuing high-impact research, major interdisciplinary projects, and high-profile international collaborations. We plan to increase our annual research income to $10M per year over the next 3-4 years. FAS will reward research excellence through the tenure/promotion process and other incentives including nominations for prestigious external awards. We also plan to introduce internal grant reviews and work with the research grants facilitators to improve our success rate in NSERC and other competitions.

- **Build research faculty complement** – FAS has lost a number of tenured/tenure-track faculty positions in Burnaby due to budget cuts over the past 5 years. This is a serious threat to our research excellence and graduate programs. FAS therefore endeavours to fill all positions vacated through resignations and retirements to maintain our research competitiveness unless the academic units decide to reallocate resources to support other needs such as TA funding. The new hires will be made to build on strengths and to address strategic needs instead of allocating positions based on historical distributions between areas. We also plan to participate in the Surrey Campus expansion to increase our faculty complement and strengthen research excellence and graduate programs.
- Create research chairs in strategic areas – We have had recent successes in fundraising for research chairs (e.g. LEEF Chair and MDA Chair) and plan to pursue additional research chairs in clean energy, large scale data analysis, green computing and biomedical technology. These opportunities also allow us address retention issues as well as rewarding merit.

- Strengthen collaboration with industry and other research partners - FAS has been successful in recent years in attracting major funding through research partnership programs such as Automotive Partnership Program and NSERC. A permanent staff position with responsibility to support industry and external relations will be established. We plan to hold industry networking events and industry site visits to promote collaboration with industry. FAS will work with regional municipalities and health authorities, especially the City of Surrey and Fraser Health Authority to support their efforts to establish technology clusters and research capacity building.

7.3 Engaging Communities

- Strengthen alumni engagement – FAS plans to strengthen its alumni engagement over the next five years. We have recently launched an e-newsletter and plan to have an annual alumni event. Alumni support will also be sought for a range of activities including the co-op program development, student recruitment, industry liaison and curriculum development initiatives.

- Pursue additional international partnerships – The dual-degree program with Zhejiang University is one of the most successful international partnership programs in Canada. FAS plans to develop two or three new international partnerships to further strengthen our international profile and outreach. We will examine partnerships at the undergraduate as well as graduate level with reputable institutions in Brazil, India and China to deliver sandwich degree programs. Another area of interest is to increase the international placements for co-op students.

- Strengthen external relations – FAS intends to work closely with Associate Vice President, External, to build relationships with local communities. Over the past three years, we have developed a productive relationship with the City of Surrey and several local industry partners. We plan to increase these collaborations and work closely with local municipalities, industry, health agencies, government agencies, business groups, school boards and community organizations to promote economic development and assist in capacity building.

- Develop professional graduate programs – FAS plans to develop professional graduate programs directed to selected industry sectors. Potential areas are large-scale data analysis, health informatics, mechatronics and communication engineering. These programs can also be targeted to new immigrants interested in upgrading their qualifications. Potential for collaboration with Life-Long Learning will be explored.
8. Possible Long-Term Growth Scenarios

(a) We plan to develop 2-3 professional masters programs in Burnaby and Surrey over the next 5 years. Tuition will be set at a level to operate these programs on full cost-recovery basis.

(b) FAS plans to actively participate in the Surrey campus expansion. The following programs will be proposed for this expansion.

- **Energy Systems Engineering** – A preliminary proposal was submitted to the government in 2010. A provincial grant was received for curriculum development and a draft program curriculum with learning outcomes is in place. We propose to have 360 UG (include international) and 100 PG FTE in this program at steady-state. This program would require a new building with appropriate services (high voltage power, compressed air, fume hoods, engine test cells, strong floors, etc) to house laboratories. The current critical space needs of MSE can also be accommodated by a new building.

- **Health Informatics** – This is a joint initiative with Faculty of Health Sciences with potential participation of other Faculties. A draft curriculum is available and discussions with industry and health agencies are in progress to receive curriculum input. Estimated enrolment is 160 UG FTE and 40 PG FTE at steady-state.

- **Expansion of MSE and SoSy Programs** – The demand for MSE is strong. However, the program runs with minimum resources and has a high risk of losing accreditation due to a very low faculty complement, space issues and laboratory support. We propose to increase the total UG PFTE allocation to MSE by 100 to add more resources to ensure long-term accreditation of the program. Assuming a continuation of the trend of growing student demand, an UG PFTE allocation of 90 will be proposed to the SoSy program to take the overall enrolment to 240 PFTE from the current level of 150 PFTE.

(c) Demand for Burnaby Programs – We plan to monitor the demand for our programs in Burnaby as recent trends show increasing enrolment. It will be necessary for FAS to work with SCEMP to increase our FTE allocation if the current trend continues.

9. Communication

The Faculty organized a retreat in April 2012 to initiate the academic planning process. This event was attended by Faculty leadership group and relevant staff members. Two town hall meetings were held in June to receive feedback from faculty, staff and students. The schools were engaged in planning through their executive committees over the summer. The school academic plans were submitted to the Dean in mid-August and these were also distributed within each school. The Dean presented the
key elements of Faculty academic plan to faculty, staff and students in two town hall meetings held in Burnaby and Surrey campuses in September. The final version of the Faculty Academic Plan will be distributed to all members of FAS in October. Annual town hall meetings will be held to report progress and receive feedback from faculty, staff and students.

**10. Supporting Financial Data for New/Growth initiatives**

See attached Excel spreadsheet.