

Final Assessment Report

Science and Business (BSc), Biotechnology- Economics (BSc), Biotechnology-CPA (BSc)

June 2020

Executive Summary

External reviewers found that the Science and Business (BSc), Biotechnology-Economics (BSc) and Biotechnology-CPA (BSc) programs delivered by the Faculty of Science were in good standing.

“We found all three programs in good standing with good student performance.”

A total of 5 recommendations were provided by the reviewers. In response, the program created a plan outlining the specific actions proposed to address each recommendation as well as a timeline for implementation. The next cyclical review for this program is scheduled for 2024-2025.

Background

In accordance with the University of Waterloo’s Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the Honours Regular and Honours Co-operative Science and Business (BSc), Honours Co-operative Biotechnology-Economics (BSc) and Honours Co-operative Biotechnology-CPA (BSc) programs delivered by the Faculty of Science.

Initiated between 1998 and 2000, these programs are housed in the Faculty of Science and are run from the Dean of Science Office. Students are taught predominantly by domain experts in the four Science departments and in the Faculty of Arts (dominantly School of Accounting and Finance and Department of Economics) as well as several Science instructors who have had extended applied careers in a variety of science and business areas. During the review period (2010-2017), the average fall enrolment (all years) was approximately 400, with over 60 degrees awarded annually (see below). Enrolment increased in SC-BUS, decreased in BT-ECON and remained stable in BT-CPA.

Enrolment and Degrees Awarded During the Review Period (2010-2017)

	SC-BUS (Reg + Co-op)	BT-ECON (Co-op)	BT-CPA (Co-op)
Average Total Fall Enrolment (all Years)	300	44	51
Average Annual Degrees Earned	45	8	10

A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Academic on November 16, 2018. The self-study (Volume I) presented the program descriptions and learning outcomes, an analytical assessment of the programs, including the data collected from a student survey, along with the standard data package prepared by the Office of Institutional Analysis & Planning (IAP). The CVs for each faculty member with a key role in the delivery of the program(s) were included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Academic: Dr. Kin Lo, Professor, Sauder School of Business, University of British Columbia, and Dr. Darren Meister, Associate Professor, Ivey Business School, Western University.

Reviewers appraised the self-study documentation and conducted a site visit to the University on March 19 and 20, 2019. An internal reviewer from the University of Waterloo, Dr. Paul Marriott, Professor in the Department of Statistics and Actuarial Science, was selected to accompany the external reviewers. The visit included interviews with the Associate Vice-President, Academic; Dean of the Faculty of Science; Science Associate Dean, Undergraduate; Director of the Science and Business programs; and meetings with faculty members and instructors, staff and current students. The Review Team also had an opportunity to tour the facilities and meet with representatives from the Library, and Co-operative Education.

This final assessment report is based on information extracted, in many cases verbatim, from the self-study, the external reviewers' report and the program response.

Program Characteristics

Science and Business (SC-BUS): The SC-BUS program (regular and co-op) allows students to develop a foundation both in science and its implementation within business and government. By providing knowledge in science, business, and information technology and skills in critical thinking, decision-making, oral presentations, conflict management and teamwork, the program aims to prepare students for management careers in the technology-intensive global marketplace. Key features of the program include: 10.0 units of science (with conditions on level), 6.0-7.0 units of business, 1.0 unit of mathematics, 0.5 unit of computer science, and 3.0 units of SCBUS workshops.

SC-BUS is also offered with seven specializations: Biology, Biochemistry, Biotechnology, Chemistry, Earth Sciences, Environmental Sciences, and Physics.

Biotechnology/Economics (BT-ECON): The BT-ECON program allows students to acquire knowledge of scientific principles and key economic concepts to help transform research ideas into new processes and products. The program prepares students for careers as economic forecasters, business or government economists, scientific research managers or regulatory

analysts. Key features of the program include: 11.75 units of science, 7.0 units of economics and 2.0 units of SCBUS workshops.

Biotechnology/Chartered Professional Accountancy (BT-CPA): The BT-CPA program enables students to provide accounting and advisory services in the rapidly growing biotechnology business sector of the economy. The program prepares students to become professional accountants who work in the public, industry or government sectors, with an understanding of the specialized needs of biotechnology. Features of the program include: 8.75 units of science, 10.5 units of accountancy, 3.0 units that include statistics, mathematics, computer science, and speech communication and 0.5 unit of SCBUS workshop.

Summary of Strengths, Challenges and Weaknesses based on Self-Study

Strengths

SC-BUS, BT-ECON and BT-CPA share a number of strengths in that they:

- Are purposefully designed to support students attaining knowledge, skills and judgment in two importantly intersecting fields: science and business.
- Allow opportunities for students to develop professional skills and pursue viable career options, with high employability according to survey data of graduating students.
- Create a close-knit, active and inclusive community that includes professional and personal mentoring and a potentially strong professional network after graduation.
- Provide above-average salaried work term employment opportunities that are valued as judged by both students and employers.
- Provide women with a destination for quality science training (a traditionally underrepresented gender in some Science programs).

SC-BUS:

- Develops teamwork, critical thinking, leadership and presentation skills through scaffolded SCBUS workshop courses.
- Enjoys steady and growing enrolment with above average retention rates.
- Allows flexible and multidisciplinary focus within science field.

BT-ECON:

- Attracts academically strong students.
- Develops teamwork, critical thinking, leadership and presentation skills through scaffolded SCBUS workshop courses.

BT-CPA:

- Attracts academically strong students.
- Experiences high program retention rate.
- Provides an efficient pathway (along with 8-month MAcc degree) to sit Common Final Examination (CFE) for the chartered professional accountant designation.

Challenges

At the end of the review period (2010-2017), the following statements were valid.

The challenges common to all three programs are:

- There has been no program-specific curriculum committee, and so curricular review and renewal has been largely limited to that required for program self-studies.
- There is limited integration of science and business concepts and applications outside the SCBUS workshop courses and limited integration with Velocity Science and other UWaterloo innovation and entrepreneurship programs.
- Sessional instructors are needed to meet SC-BUS teaching needs.

SC-BUS:

- Co-op visa student enrolment has been declining for reasons that are unclear as of yet.
- The SCBUS program prepares students for careers both in the science or the business sector. Each sector uses a different mix of the graduate's science and business skills. Students typically align themselves into one sector or another as a result of their co-op experiences. Based on the Science Advancement Intentions Survey done just before graduation, post-graduation positions are predominantly focussed in the business sector (with consultants or financial institutions) as opposed to product or technology development with science/technology firms.

BT-ECON and BT-CPA:

- The course requirements are highly prescribed with little to no flexibility (e.g., ≤ 1 free elective).
- The linkages between academic theory and practical application are not deep.
- These are niche programs with likely limited growth potential.

Weaknesses

SC-BUS:

- The SC-BUS program exists as 16 academic plans (i.e., a regular and co-op stream of SC-BUS, plus 7 SC-BUS specializations), yet the 8 physical science specializations (Chemistry, Earth Sciences, Environmental Sciences, Physics) account for only 10% of graduates. Academic plans with low enrolment lead to unwarranted recruitment, administrative, advising and support costs.
- The retention rate for SC-BUS regular is low; most students leave SC-BUS (voluntarily or involuntarily) or modify their plan to SC-BUS co-op.

BT-ECON:

- Retention is relatively low and decreasing further. While there is no obvious decline in the number of students starting BT-ECON during the review period, an increasing number

are transferring to another program, typically SC-BUS co-op or Honours Biology co-op. The viability of this program long-term must be critically appraised.

- Co-op work placements in Science-specific positions have been limited to-date for this cohort.

Summary of Key Findings from the External Reviewers

The external reviewers found all three programs in good standing with good student performance. They observed that the BT-ECON program has a strong incoming class, but a low number of students graduating as they switch in to other programs. The reviewers did not find strong reasons to continue the BT-ECON program; alternatively, the Faculty could look at easing progression requirements and increasing flexibility in the program to improve retention.

Program Response to External Reviewers' Recommendations

Recommendations

As per the Implementation Plan that follows, the Director of Science and Business is responsible for leading the initiatives described below.

1. Develop a strategic vision for the programs.

Response

The reviewers recommended a strategic vision be developed as they found differing perspectives of the programs (e.g., science-based programs with a business perspective versus business programs drawn from science students).

To-date, these dual identities have served the programs well. While the finalization of the Faculty of Science strategic plan is pending, there is clear direction from the Dean and the Associate Dean of Science, Undergraduate Studies to the three-member, instructional Science & Business team (two faculty members, one of whom is the Director, and a third who is a staff member) about the role of the Science and Business programs in the Faculty.

In 2016 (the latter portion of the program review period), the SCBUS team created a mission, a vision, values, positioning and a key skill list for the programs; this work was shared with and supported by the Associate Dean of Science, Undergraduate Studies. Led by the Science & Business Director, this document will be reviewed and adjusted accordingly by the team after considering the current University strategic plan and the updated Faculty strategic plan. Thus, this review process will provide additional guidance on scope of the programs, guidelines for growth and program continuity, curriculum needs and faculty hiring requirements.

The reviewers also recommended growth options and priorities be examined for the programs. This will be done during the strategic review described above. In addition to the strategic overview described above, many other factors impact the growth of these programs. For example, senior faculty (Dean, Associate Dean Undergraduate, Director Science and Business) must assess and balance:

- Faculty of Science enrollment targets with respect to the overall incoming pool of students.
- Program growth and strategic priorities across the Faculty of Science.
- Domestic and international student considerations and related ratios.
- Ratio of direct entry SC-BUS students in first year versus transfer-ins during upper years.
- Core program characteristics (e.g. group work is a key part of the SC-BUS courses. Since ideal group size is known to be 6-8, when SC-BUS groups exceed 10-12, the goals of the program are compromised).
- The loss of incoming students from the Chinese University of Geosciences Beijing (CUGB) 2 +2 program.
- Student enrollment and retention factors related to the BT-ECON program with respect to direct entry and low retention.

2. Rationalize the program options.

Response

During the review period, there were 16 SC-BUS academic plans (including seven specializations, offered in co-op and regular streams of study), plus BT-ECON and BT-CPA.

SC-BUS: Eight SC-BUS specialization academic plans were inactivated for Fall 2019 or Fall 2020 because of consistently low enrollments (Chemistry, Earth Sciences, Environmental Sciences, and Physics, in co-op and regular streams of study).

As part of the ongoing strategic vision process mentioned above, the remaining SC-BUS specializations will be reviewed. Potential outcomes to be explored will include maintaining the continuing specializations focused in areas of life sciences, where enrolment has been consistently focused or, alternatively, re-configuring the specializations into two broader-based specializations (Life Sciences and Physical Sciences), offered in both streams of study. The current intention is to maintain the existing set of eight SC-BUS academic plans.

BT-ECON: The declining enrolment and low program retention rate documented during the program review necessitated considerations that included either changes to admission criteria and curriculum or inactivation of the program. The reviewers suggested a possible reconfiguration of the program into a SC-BUS, Economics specialization. This option was considered but would have resulted in insufficient science content for a BSc degree. As a

result, because of the declining enrolment and sustained low retention, BT ECON was inactivated for Fall 2021.

BT-CPA: While the program is small, it is a successful, unique program with a high retention rate. Little change is anticipated. Since the review period, applications from visa students have been allowed; this is expected to increase enrolment. Attention to the program will focus on curriculum review regarding flexibility and concept integration (see Recommendation 5). As of January 2020, the review has been completed and program structure maintained.

3. Improve branding internally and externally.

Response

Since 2017 and ongoing to present, the external recruitment profile and material is and has been reviewed and updated to align with Science and Marketing and Undergraduate Recruitment (MUR) objectives and guidelines (e.g., presence in Faculty of Science brochure, program brochures, Science & Business and MUR websites, Fall Open House presentations, website upgrades, OUF presence). The plan is to maintain this strong external branding. The internal branding will be coherent with the external branding.

Some of the program instructors are cross-appointed into relevant Science departments and participate in departmental activities. The perceived limited awareness or understanding of these programs by the Science departments will be addressed by presentations at their departmental faculty meetings and inclusion of departmental representatives on the curriculum committee (see Recommendation 5); these presentations are occurring in 2020.

4. Continue to Build Faculty Complement.

Response

Subsequent to the strategic vision review and the program rationalization, the faculty complement will be considered further; however, the complement may not need to be increased. Since 2015, two dedicated lecturers with different backgrounds were hired by the Dean of Science (one began after the review period ended). These additional faculty members have allowed academic and service duties to be more equitably distributed and single points of failure in teaching and service duties to be mitigated. It has also allowed the resourcing and activation of SCBUS 424, the capstone course. The new faculty members are cross-appointed to relevant Science departments, helping them to bring new knowledge to the classroom. The suggestion of adding a faculty member with scholarship commitments will be reviewed with the Dean of Science, after the strategic vision review. Any increase in faculty complement would be funded by the Dean of Science Office; currently there is no plan to increase the complement.

During the review period, a sessional instructor was hired to address the commitment made to the China University of Geosciences, Beijing (CUGB) to offer the SC-BUS Earth Sciences specialization (regular) plan as part of a 2+2 agreement. As of Fall 2019, this hire was no longer needed because the SC-BUS Earth Sciences specialization was inactivated due to low enrolment.

5. Create a Curriculum Review Committee.

Response

This is being created in Spring 2020 by the Director of Science and Business in consultation with the Associate Dean, Science, Undergraduate Studies. The function of this committee, in general, will be to review, update, guide and maintain the programs on an appropriate timeline as needed. They will develop a frame of reference, then review, use and build on the corpus of materials available now (curriculum maps, program objectives, yearly program outline diagrams, revised calendar descriptions of the SCBUS workshops, newly defined Areas of Emphasis, recommended electives and academic requirements defined by Chartered Professional Accountants of Ontario, where relevant).

Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	Develop a strategic vision for the programs.	Continue to implement existing program strategic direction.	Director, Science and Business	On going
Review SCBUS strategic vision subsequent to current University and pending Faculty Strategic Plans. Director to discuss with stakeholders including Dean of Science, Associate Dean of Science, Undergraduate Studies, Departmental Chairs, SCBUS team etc. Align if needed.		Director, Science and Business	The latest University Strategic Plan was released in Fall 2019. The creation of the Science Strategic Plan is in progress. Review implications of these Strategic Plans for SC-BUS, BT-ECON and BT CPA (expected by end of 2020).	
Set growth priority and targets for the programs within the frame of Faculty of Science. Director to discuss with Dean of Science, Associate Dean Undergrad, Marketing and Undergraduate Recruitment (MUR), Registrar's Office, Institutional Analysis and Planning (IAP), SCBUS faculty and staff etc.		Director, Science and Business	Completed, Fall 2019	

2.	Rationalize the program options	Determine optimal number and type of SC-BUS specializations. Director to discuss with relevant stakeholders such as Dean of Science, Associate Dean Undergrad, Departmental Chairmen, SCBUS faculty and staff etc.	Director, Science and Business	Complete. Eight specializations were deactivated due to low enrolments: Chemistry regular & coop, Physics regular & co-op, Environmental Services regular & co-op, Earth Sciences regular & co-op (7 inactivated for Fall 2019; Earth Sciences regular inactivated for Fall 2020).
		Review BT-ECON program with a view to either reformulating or inactivating. Director to discuss with above stakeholders	Director, Science and Business	Complete. Program deactivated for Fall 2021 (declining enrolment and low retention).
		Review structure of BT-CPA. Either reformulate as Science-CPA or leave as status quo. Director to discuss with above stakeholders	Director, Science and Business	Review completed and program structure maintained.
3.	Improve branding internally and externally	Continue to collaborate with MUR and Science Recruitment on recruitment activities (events, materials, websites).	Director, Science and Business	Ongoing
		Improve hallway signage near SCBUS instructor hub area.	Director, Science and Business	Started. Conclude in Fall 2020
		Create and give 10 minute presentation to relevant SCI and ARTS Departments and other stakeholder groups	Director, Science and Business	Started. Complete in Fall 2020
		Maintain SCBUS website and contribute to MUR SCBUS website	Director, Science And Business	Ongoing

		Nominate SCBUS alum for relevant awards	Director, Science and Business	Ongoing as per Advancement deadlines
4.	Continue to Build Faculty Complement	Programs are currently suitably staffed. Should this change, see Recommendation #1.	Director, Science and Business	As necessary. Specific intervention not foreseen in near term.
5.	Create a Curriculum Review Committee (CRC)	Create CRC chaired by Director, run by Academic Advisor and having membership from Science and Arts Departments and a program student.	Director, Science and Business	In-progress (Spring 2020).
		Set Terms of Reference and review and prioritize items from Reviewers' Report	Director, Science and Business	Not applicable until CRC struck.
		Ongoing commitment to scholarly review	Director, Science and Business	In the meantime, curriculum discussion and responsive changes continue. For instance, changes to the BT-CPA plan have been approved by SUC for Fall 2021.



Date of next program review _____ 2024-2025 _____
Date

Signatures of Approval

J. Richardson _____ Jan 17 2020 _____
Chair/Director Date

AFIW Administrative Dean/Head (For AFIW programs only) _____ Date

[Signature] _____ 17.1.20 _____
Faculty Dean Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.

Dave Dell'Acqua _____ January 2020 _____
Associate Vice-President, Academic Date
(For undergraduate and augmented programs)

Associate Vice-President, Graduate Studies and Postdoctoral Affairs _____ Date
(For graduate and augmented programs)

Checklist for SUC/SGRC Reviewer Feedback Quality Assurance Office

**Final Assessment Report: Science and Business (BSc), Biotechnology-Economics (BSc),
Biotechnology-CPA (BSc)**

Name of Reviewer: Benoit Charbonneau

Date: 7/16/2020

Does the Final Assessment Report:

1. Include a credible implementation plan that not only addresses the substantive issues identified from the program review process, but also clearly identifies:
 - The actions that will follow from specific recommendations? **Yes** **No**
 - Those who will be responsible for acting on those recommendations? **Yes** **No**
 - Those who will be responsible for providing resources? **Yes** **No**
 - Priorities for implementation and realistic timelines for initiating and monitoring actions? **Yes** **No**
2. Provide rationales for any recommendations that have not been pursued? **Yes** **No**

General Comments

This FAR clearly addresses the external reviewers' recommendations. For some recommendations, work has already been done and completed.

Requested Revisions

A large number of revisions were asked, but they seem to come mainly from two issues:

- The original version did not make it clear to someone outside the Faculty of Science how the program was structured, where it was housed etc. Some of that became clearer when one got to the Implementation Plan table at the end of the document, but it was very difficult to understand the main text without that context.
- The original version was not clear on timing. For instance, it mentioned existing material and that seemed to contradict implicitly recommendations that took place in the program review. Upon revision of the FAR, it became clear the material has been created in reaction to the recommendations. It would be prudent to remind the writer of how long these whole review processes last, since reading the document can take place a long time after it is written.

The revised version addresses these concerns and some other minor concerns.

Checklist for SUC/SGRC Reviewer Feedback Quality Assurance Office

Final Assessment Report:

Name of Reviewer:

Date:

Does the Final Assessment Report:

1. Include a credible implementation plan that not only addresses the substantive issues identified from the program review process, but also clearly identifies:
 - The actions that will follow from specific recommendations? Yes No
 - Those who will be responsible for acting on those recommendations? Yes No
 - Those who will be responsible for providing resources? Yes No
 - Priorities for implementation and realistic timelines for initiating and monitoring actions? Yes No
2. Provide rationales for any recommendations that have not been pursued? Yes No

General Comments

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