

Review of the Division of Biomedical Engineering

External Reviewers Report

External Review Team

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Introduction

This report is being submitted to the Dr. Ernie Barber, Dean of the College of Engineering (Review Sponsor) as part of a review of the Division of Biomedical Engineering, University of Saskatchewan. The mandate of the review was identified as:

"To review the Division's mandate, governance, infrastructure and long-term vision and maximize its success across the spectrum of research, teaching, outreach, and service to support the goals of the University of Saskatchewan."

This report is based on:

1. A self-assessment report (Zhang WJ, Division of Biomedical Engineering: Overview and Self-Assessment, Division of Biomedical Engineering, December 20, 2011.)
2. A visit by the external review team (February 21, 2012)
3. Student survey constructed by a the external review team and delivered by Phani Adapa (Review Project Manager)

Key findings

The following are the main findings of the external review team.

Division's research community and productivity

The members of the Division are part of a long established research community that is collegial and supportive. Membership appears to be diverse and multidisciplinary, spanning multiple academic units across the university, including engineering, medicine, veterinary medicine, and science. There is a clear desire by several of the members that were present during the review to strive for a high level of excellence and make the Division stronger, the Division currently knows that it lacks the resources that it needs, and also feels that it does not have control over their future..

Productivity of the Division appears to be good based on the self-assessment report. It is noted that research outputs as measured by publications in 2010/11 were almost double previous years, which likely points to increased productivity but the increase may also include some contribution from normal variation. It is unclear from the report how uniform the productivity is within the Division (i.e., is everyone contributing or is the productivity the result of a few individuals), but of course a distribution is to be expected. AS is challenging in cross-disciplinary groups, it is also not possible to discern whether the metrics provided (e.g., publications, funding, HQP training) are individually activities that are solely associated with the Division or all activities associated with members of the Division (e.g., have members of the Division included their non-biomedical engineering related publications in these metrics). In addition, while the Division is multidisciplinary, it is not readily apparent how interdisciplinary it is; a multidisciplinary unit may have researchers from a broad range of disciplines but still working within their own silos. It may be possible to gauge the level of interdisciplinary work by examining the amount of collaborative work across disciplines (e.g., publications, grants, and co-supervision). As well, an interdisciplinary group can have a positive impact beyond the core field of the Division under consideration. Nevertheless, it is suggested that Division examine their data, with attention to these details, as it would ensure a realistic picture of the Division's operations.

Positioning of the University of Saskatchewan

The University of Saskatchewan is well-positioned to be a leader within biomedical engineering. The university has a number of unique features that make it well-suited to biomedical engineering, including a diverse health sciences presence (e.g., medicine, veterinary medicine, dentistry, nursing, physical therapy, and kinesiology) and well-recognized research institutes (e.g., CLS, VIDO, PBI). The right building blocks are present within the University of Saskatchewan to achieve excellence within biomedical engineering but it must ensure that it leverages effectively its current related strengths.

Positioning of Division within the University of Saskatchewan

The organizational structure of the Division within the University of Saskatchewan does not appear to be optimal and may be restrictive.

While the Division is within the College of Graduate Studies and Research, its operational control has been delegated to the College of Engineering. While the Division attempts to strive for interdisciplinary research across multiple academic units across the University of Saskatchewan, being effectively situated within a College of Engineering can be restrictive, particularly if inadequate resources are apportioned for their activities. The Division has a

number of courses, administrative duties (e.g., executive committee), and resource needs (e.g., student space) that can be negatively impacted by the governance structure. As Division members are associated primarily with a particular academic unit, contributions to the Division (e.g., teaching/administrative loads) either take away from the member's primary academic unit or is not considered (i.e., taken on as an extra load and viewed as "voluntary" work). Furthermore, collaborations outside of the College of Engineering rely heavily on shared interest and good-will. In addition, activities of the Division that are outside the College of Engineering are less readily visible and thus may not be as valued by their peers. While the Division is accountable for its activities, it does not seem to be given the resources to effectively be accountable for its activities.

While the external review team believes that there is a need to restructure the Division, it is not clear what the optimal structure would be within the University. Several structures exist that could be candidates such as a Division with the College of Graduate Studies and Research, a School, a Research Institute, or even a hybrid structure equivalent to a department potentially within multiple Colleges.

Disconnect between students/faculty/program

As noted above, the Division appears to have a healthy community among its key members at the faculty level; however, there appears to be a disconnect between the students and faculty. For students, there does not appear to be regular activities that would help build a sense of community for them. The students largely function within the departments or laboratories of their supervisors, and seldom interact with other students of the Division, or other Faculty of the Division. Without adequate resources to fund Division activities such as a weekly seminar series or student/faculty events, the community cannot be built.

The biomedical program does not have any core courses, which could serve as a forum for interaction. In fact, the biomedical program does not require students to take any of Division's BIOE courses, which has the potential for students not to be well-engaged within the field of biomedical engineering. The Division hosts a seminar series but it is only held once a year. This does not encourage interconnections and community building. Students form connections that last their professional career and often these connections are investments that return back to the department or division through commercialization of research or alumni engagement. This opportunity is being missed.

The Division has student space in the Engineering building and the Animal Sciences building, which could provide a physical area for interaction; however, convenient space that is available is limited. Although it appears that the less convenient space in the Animal Sciences building is underutilized. Indeed, some students were not even aware that such space exists. Most students use space associated with their supervisor's laboratory and thus have a stronger affiliation to members of that laboratory and academic unit, rather than the Division and biomedical engineering. Finally, Division communications is sporadic and mainly one-way, comprising email notices from the Division administrator. Students express confusion and frustrations resulting from a lack of understanding of how the Division is structured and thus whom to turn to for assistance. It is noted that students are happy with the interactions they have with members of the Division when they do occur.

Interdisciplinary research should occur at all levels and promoting good interactions at the student level is valuable from a learning and research perspective, while increasing the quality of students' education experiences.

The external review team recommends that the Division consider:

1. the introduction of a core, compulsory biomedical engineering course; or alternatively a list of core courses from which students must take a majority. For example 2 of the 3 core courses.
2. changing the annual seminar to a weekly or biweekly seminar with mandatory attendance.
3. establishing and supporting a student biomedical engineering society; and
4. improving student interaction through improvements in their shared spaces, such as trying to physically locate biomedical engineering students together.

Support staff

The Division has a 1/4 administrative staff position, whose main duties appears to be the handling and processing of the student files. Other administrative workload that would normally fall to a staff member, is believed to be performed by the Division members themselves, likely with assistance from staff from their own academic units. Such an ad hoc arrangement is not efficient. Student files may be handled following processes that differ between departments for example. This arrangement also does not sufficiently support the needs of the Division (e.g., effective communications between Division members and HQP, support for a seminar series, support for courses, etc.). This also limits the growth potential of the Division. New initiatives such as new courses, new labs, or even reorganizing the seminar series that support the Division may seem impossible.

Opportunity for Division to play a role in the examination and establishment of quality standards for biomedical engineering training in Canada.

Biomedical Engineering is an interdisciplinary field and has developed into programs relatively recently in Universities across the Country. While there are similarities in purpose at each center, there is a wide variety of approaches to what constitutes a graduate degree in Biomedical Engineering, and recently, there has been some discussion amongst some Division and Department Heads from programs in Canada that the approaches to training of Biomedical Engineering Graduate students in Canada needs some discussion and attention. While this discussion within the biomedical engineering community in Canada is at a very early point the Division may be able to play an important role in this upcoming discussion as it shapes its program.

Opportunity to promote commercialization

The Division may also have an opportunity to promote commercialization of its research activities. Support for innovation in research and development in Medical technologies and devices is increasing in Canada. The Division and the University of Saskatchewan is well-placed to develop and innovate medical technology because unlike many Universities of similar size, the University of Saskatchewan has all the health related associated disciplines in one centre –

Not only Medicine and all the health professions, but also Dentistry and veterinary medicine. Together with strengths such as the Canadian Light source and the Vaccine and Infections Disease Organization, this is a rich environment for spawning research and innovation that may be commercializable. The reviewers felt the University should recognize the potential for the Division and support the Division as it develops a strategy to build an environment for students and faculty to foster connections with industry and promote commercialization activities.

Review

The external review team was given a project scope that is being addressed directly within this section.

1) Mandate

a) How well is the Division fulfilling its goals and objectives?

A key component of the Division's mandate is interdisciplinary research as indicated in the Division's Mission. While the Division is multidisciplinary, with membership from a variety of disciplines, spanning multiple academic units, it is challenging to quantify how well the Division is meeting this objective. It is recognized that it is always a challenge to quantify and account for interdisciplinary research objectives. While the research productivity is growing, and does span a number of disciplines, the information provided does not enable the external review team to discern whether or not the Division is an umbrella that encompasses a number of silos. That is the research may be isolated faculty members and their labs more than research that crosses between members of the colleges of Engineering and Medicine. However, an examination of the graduate students (Appendix D and E of the self-assessment) does reveal a number of co-supervisions across disciplines (e.g., mechanical engineering/anatomy and cell biology, electrical engineering/biology, mechanical engineering/veterinary medicine, mechanical engineering/VIDO). This is a good indication that the Division is in part succeeding in this objective. It is also noted however, that the majority of HQP are from engineering, rather than from a more diverse background of disciplines. Such data mining can be extended beyond training of HQP to including publications and grants to better assess the true interdisciplinary activity within the Division, if the Division wished to better quantify this activity.

It was not apparent to the external review team how the Division is actively promoting interdisciplinary objectives. By virtue of its existence, the Division provides an entity to work under; however, the Division should be taking an active role in this pursuit. Ensuring active networking between researchers and HQP across disciplines is an important part of building collaborations, providing an opportunity to build knowledge of each other's research activities, as well as a regular forum to interact. The seminar series would be an example of such activities; however, it is an annual event in its current form providing only limited interactions. More student interaction through participation in shared courses can also foster more collaborations as students share information and ultimately share tools and research objectives.

Part of the mandate review refers to engagement to external community and stakeholders; however, this is absent from the specified mandate of the Division.

b) How well does the Division's mandate align with the strategic priorities of the University of Saskatchewan?

The strategic priorities were derived from information available on the University of Saskatchewan website; specifically, *Promise and Potential* the University's third integrated strategic plan.

It was noted in the self-assessment that the Division's research activities align with two of the University's six signature areas: Area I: One Health: Solutions at the Animal-Human-Environment Interface and Area II: Synchrotron Sciences: Innovation in Health, Environment and Advanced Technologies; however, the self-assessment only cites one publication of evidence of alignment. Appendix D of the self-assessment provides a list of current HQP. ON the whole, examining the specified areas of research, a clear alignment with Area I can be easily seen, which is expected given the Division's focus of biomedical engineering. Alignment with Area II appears to be quite limited, and the Division is encouraged to examine what elements of their members contribute to this strategic priority.

Promise and Potential identifies four areas of focus, two of which the external review team believes the Division can address: 1) Knowledge Creation: Innovation and Impact and 2) Innovation in Academic Programs and Services.

Research within the Division well supports the promise of knowledge creation. This is the strength of the Division. However because there are few courses identified as core to the biomedical engineering Training experience, other than the graduate research conducted by the students, there is little evidence of innovation in academic programs and services.

Biomedical engineering is inherently a field that is amiable to interdisciplinary research. The field of biomedical engineering is still a relatively young area with much growth potential. It is also a field that attracts many students. The review has identified a disconnect that the Division has with its current student body, who seem to be willing to contribute - given the opportunity. *Promise and Potential* notes "We have created three interdisciplinary graduate schools in public health, public policy, and environment and sustainability."; however, biomedical engineering is absent through the report. The potential for excellence in academic programming exists with the Division but it is not being realized currently.

c) What kind of research and scholarly activity occurs within the Division and what is its quality and quantity?

The self-assessment identifies 7 active areas of research focus in the Division on page 8. While the review committee was not provided with a publication or grant listing from Division members, to a limited extent it was possible to examine the research areas from the description of research areas for current HQP as provided from Appendix D of the self-assessment. This seems to suggest that the level activity within each of these 7 areas is quite varied. This is to be expected from an interdisciplinary program. However, in addition, it appears that much of the supervision of HQP is being performed by fraction of the 53 Division members. A measure of quality is indirectly provided from the level of funding support for the

Division activities, which indicates possibly healthy annual support of \$7.5M although the distribution of funding amongst Division members is unclear.

It is unclear if the totals in funding and in publications reflect all activities associated with Division members or only activities of Division members that are related to the Division (i.e., only biomedical related funding and publications). The publication output for 2010/11 was good for the 53 members, with 104 and 65 journal and conference papers, respectively; however, it is noted that this amount appears as an outlier compared to the previous 5 years (e.g., average journal publication rate was 1.16 per person). The Division had a significant increase in members from 2006/07 to 2008/09, increase from 24 to 49 members. The recent doubling of members is a good sign and may reflect new researchers establishing themselves. If true than this bodes well for the future, as output will likely grow further from this point, as these labs strive to reach their potential for research output.

Although the quality can be indirectly assessed from the level of peer-review support, better information could be gathered from Division publications listings, publication impact and the amount of knowledge translation.

d) Is the Division's commitment to research and scholarly activities consistent with trends and expectations? Do they serve the needs of students?

The Division appears committed to research activities and the members seem to be quite collegial and open to each other; however, the academic program, environment, and structure are far from optimal in taking full advantage of opportunities. There does not appear to be a regular forum for researchers to interact and discover new opportunities for collaboration. This is particular true for students, who lack consistent opportunities to even interact with each other. For example, there are no core biomedical engineering courses for students to meet each other. In fact the program does not seem to require students to take any of the Division's biomedical engineering courses, so students may potentially have very little connection with biomedical engineering. While the Division does hold a seminar series, this only occurs once a year. Communication within the Division is limited with only minimal associated staff. Given the spread of disciplinary backgrounds, as well as the spread in terms of physical location of Division members and students, attention must be given to ensure regular, good interactions.

e) Are there important areas of concentration, strength, or innovation that the Division should be pursuing?

The Division has research strengths as indicated in the Self-Assessment page 8 and reproduced here, in the areas of:

- (1) Tissue engineering,
- (2) BioMEMS/BioNEMS,
- (3) Medical imaging including synchrotron radiation technology,
- (4) Rehabilitation and assistive robots,
- (5) Bioinformatics and systems biology,
- (6) Biosensor, bio-actuator, biomaterial, bio-artefact, bio-instrumentation, and

(7) Healthcare systems.

These represent the core areas of the Division, and it was difficult to assess the relative strengths of the Division amongst these categories. The sources of funding for the above areas were provided and indicate, good provincial and national support for research in (1), provincial support for (2), strong CIHR/NSERC support for (3), only NSERC support for (5) while (6) is supported by NSERC and industries. Interestingly, research in Healthcare systems is indicated as supported by the University through a faculty start-up grant, indicating the potential for growth here. This provides an indication of the strengths of the Division as past success in funding is the best indicator for future success. This has to be weighted also by the potential for growth from new faculty. The strong CIHR/NSERC support for medical imaging including the synchrotron radiation technology is a well-recognized strength for the University of Saskatchewan. Since the Division attracts the highest quality students, the Division is likely to increase in Research strength, particularly if the Division consolidates its program and builds better supports for its students.

f) Does the Division add value to research and training at the University?

The Division has existed since 1962 and its organizational structure currently depends on the good will of participating academic units (e.g., assigning courses, administrative duties, resources). The fact that the Division has existed for half a century is strong evidence in itself that it has been providing value. Further evidence is provided by the marked expansion of membership, its research activities (funding and research outputs, such as publications), and the large number of HQP.

As previously noted, the students seemed to be overlooked. This sentiment is reflected in the external review team's student survey. The survey also suggests that the students are willing to contribute actively. The Division should ensure that they provide students the opportunity to build a community and pride, which continues beyond graduation.

The value of HQP training should also be evaluated with respect to graduates. Additional information should be gathered to find out where graduates end up, as well as information from industry to better understand their needs.

g) Does the Division have meaningful impact: a) with regards to community-university relations, and/or b) in and for the various stakeholders and communities it serves?

The Division's impact is not readily apparent in the information provided. The self-assessment has a very internal view point, with limited attention given to the service the Division provides to stakeholders and communities. Section 4.5 of the self-assessment identifies a very limited amount of service to communities external to the University.

Section 8 of the Division Review Charter, identifies a number of stakeholders internal to the University. Of those identified the Division appears to have meaningful interactions mainly with the faculty members associated with the Division and its graduate students. The impact of Division faculty members appears to be positive and sense of community is apparent within the membership. The Division provides an entity with which its members associate together, and provides a structure for the recruitment of HQP. However, the impact on graduate students is

limited. Currently this provides an opportunity for growth to provide stronger sense of community amongst the students, and across students and faculty. Better and stronger organization of the students would provide greater visibility of the Division of its activities. If attempted, this needs resources and encouragement.

Information on the Division's impact on other stakeholders was limited to only those stakeholders with which the review committee met during its visit. The Division was felt generally to be doing well in a distributed sense. It was also recognized that the Division was doing good quality research and attracting high-quality students. It also had good collaborative links to some outside Universities including internationally such as the Beijing Institute of Technology.

However the potential impact of the Division within the University is likely largely limited since the Division does not seem to be provided any formal standing with other stakeholders. For example, while the Division has a responsibility for ensuring its BIOE courses are taught, it does not have the authority to assign teaching. Another example is that the Division does not appear to have representation at Engineering Faculty Council that is similar to departmental representation, despite having some similar responsibilities, particularly with respect to its students.

h) Do faculty members of the Division have an appropriate sense of their place within the University community?

As previously noted, the Division members do have a good sense of an internal community. This is in spite of the structure of the Division, where faculty members are affiliated with their own academic units, along with responsibilities and resources (e.g., teaching/administrative loads, laboratory space). As such, contributions to the Division seem to be provided on a voluntary basis or a hobby, rather than recognized formally, both within the Division and external to the Division.

The Division sense of place within the University is not clear, which impacts its function. Although officially associated with the College of Graduate Studies and Research, having been delegated to the College of Engineering, seems to limit the perceived function of the Division to engineering, despite its mandate and desire to span the University. The Division is given responsibilities with respect to academic programming and research but not provided the authority or resources, depending on good will of other academic units (e.g., teaching assignments). As common with interdisciplinary departments, the members of the Division are spread out across the University so there is no physical association. Even the virtual presence of the Division (e.g., website) is limited.

Division members have a strong desire to contribute and display a high level of collegiality. While the University administration expresses support for the Division, this sentiment is not well perceived by the Division who feel under recognized and not well supported.

The scope of the Division is broad and seemingly ad hoc. Moving forward, the external review team believes that the Division should identify a more solid strategic plan on how to move forward. This includes identifying concrete goals derived from the mission and values statements. While there is a seemingly unified frustration and a desire to move forward, it

appears from the external review team that the Division has yet to establish a clear, common sense of direction.

Of primary importance are establishing a firmer governance model, stronger resource base, and building a greater student and student-faculty community.

Governance

a) Does the administrative structure of the Division provide the support necessary for the Division to meet its mandate?

The administrative structure does not support the Division to meet its mandate. The Division is given responsibilities (e.g., teaching and administration) but none of the authority, which rest with the department heads of academic units. The lack of control requires the Division to seek the good will of academic units, which can be time-consuming and challenging. For example, the addition of a new BIOE course that requires a teaching assignment of a faculty member would reduce the amount of teaching assignments possible for that faculty member's academic unit; demanding such a reduction in a unit's resources is difficult given the resource pressures that each academic unit head already faces.

The structure disadvantages students of the Division. Graduate students in other departments have the resources and identity afforded them via their home departments, home administrative staff and faculty members, while graduate students within the Division do not. Further, since the Division head does not have a vote or level of equivalence within the Faculty, this can have the effect that the Division and by extension the graduate students is a benefit to the Faculty on top of its primary commitments.

b) Are the accountabilities, expectations and role of the Division and the Division chair defined and understood?

As indicated in the previous question, the accountabilities of the Division and Division Chair do seem to be well-understood but the necessary authority to act for the Division members and teaching mandate is lacking. The structure of the Division is limiting the Division to achieve its full potential and the wishes of the members to accomplish more. It appears if the Division members work hard to ensure the ongoing maintenance of its operations, but given a firmer position within the University, this time could be more profitably spent improving the Division. It is advised that the Division be given the ability to establish a more equitable place within the University, and undertake some planning to choose strategic directions for an improved student and Faculty experience, and be provided with resources to achieve their goals.

Currently the Division is led by an Acting Chair, and lasting and supported leadership is needed to help guide the Division forward. The new leader should be provided with resources to develop a strategic direction for the Division, with the help of the Division executive and Division membership.

It was understood that the Division Chair is supposed to sit at the Department Heads meetings with the Dean within the college of Engineering, but it does not appear that this is currently practiced. While this would provide for a ready exchange of information from, and to, the

Division amongst the Dean and other Engineering departments, it is our understanding that the Division Chair does not technically sit as an equal to the other heads. This may have a rationale to prevent two members from the same department both sitting at the Heads meeting, for example if the Division Chair were a member of Mechanical Engineering. While having two members of one department could be perceived as achieving a stronger voice, this is not that uncommon in faculties/Schools where cross-appointments are frequent, and easily managed. However, not having the Division Chair at the Heads meetings is a genuine disadvantage to the students of the Division relative to the students of other departments, and leads to some perception that the Division is rather an added benefit to the Core programs of the College, rather than on a more equal footing. These points are currently inconsequential, however, as the Division Chair has not been at the Department Head meeting in recent history, for reasons that are not clear. Consideration must be provided to enable a formal communication channel to the Dean and the other departments and one that provides equal representation for the Biomedical Engineering Graduate students within the Division while also being effective in coordinating among departments within the College of Engineering.

Appointment of adjuncts: There appears some difficulty in how the Division can approve the appointment of adjunct professors. As the Division is not an academic unit, it does not have the authority to appoint adjunct professors directly. If the Division wishes to appoint an adjunct, it would have to do so via an academic unit. Such a process is not clear (e.g., Who brings forward the recommendation? The Division Chair, who may not be a member of the academic unit? A member of the Division that is a member of the academic unit?). Departments need the authority to recommend the approval of cross-appointed professors, and adjunct professor, subject of course to the regulations of the Faculty of Graduate studies.

c) How does the Division interact with Engineering's faculty council, CGSR's faculty council, and other college's faculty councils to ensure its program reflect the perspective of its member faculties?

This is complex for the review committee to fully assess. The Dean of the College of Graduate studies and research has delegated oversight of the Division to the Dean of Engineering. The Division has a Graduate Chair that sits on the CGSR (indicated as Dan Chen). The review committee did not assess the performance of the Graduate Chair, however the students did not report any complaints regarding this role. It is unclear if the graduate chair is granted leave of any administrative or other duties from his home department to better serve this position.

The Dean of Graduate Studies was positive concerning the Division. The Division is a vibrant group, and important to the university, is a good fit with the University. The growth of the Division is not managed in any particular way, but growth was deemed to be good for Graduate Studies. He was aware that the Division has expressed a need to improve the manner in which cross-appointments or adjunct appointments are processed, and expressed his willingness to support some mechanism to accomplish this. This knowledge indicates a working relationship with the needs of the Division, and reasonably effective communication. However, there

appears to be a communication issue with respect to the allocation of scholarships. Some Division members felt the current scholarship allocation to the Division as unfavourable, while the Dean of Graduate studies felt that the Division is actually doing rather well with its allocation. Currently BME gets between 35,000 and 80,000 in scholarships for its students, which may or may not be fair currently, but this is a fixed amount which does not grow if the Division grows.

d) What is the relationship of the Division to Research Services and to the Office of the Vice-President Research?

This difficult to assess. The review committee heard from the Assistant Dean for Research Partnerships. Currently there are 2-3 projects actively patenting their IP, which is indicative of the potential for commercialization. The Division is active in the areas of its research strengths as indicated in the self-assessment. It was noted that perhaps stronger links could be made with VIDO. On the whole there is no organization within the Division to handle Commercialization or working with industry. While this is not uncommon at the department level, there is usually a larger than normal opportunity for industry collaboration and partnering with Biomedical Engineering, and perhaps some working group could be established to examine ways to promote interaction between the Division and industry stakeholders. The Office of Research Services or the VP Research could help facilitate such activity, in collaboration with any strategic Direction the Division self-identifies.

e) Is communication within the College and between the College and other parts of the University adequate?

There are very few resources available in the Division to enhance communication to the other parts of the University. Because the Executive of the Division also has primary appointments in their home departments, it is likely that communication between the Division and the home departments of the Executive is through these natural channels. However this is not formal, and other departments in other colleges than Engineering likely do not communicate often with Division leadership including the executive. If the annual seminar series were made into a weekly or bi-weekly series a seminar coordinator would need to help organize the series and ensure communication to other departments and colleges across campus.

f) Is the leadership from other Colleges involved in evolution of the Division? What is the existing relationship of the Division with other Colleges?

The leadership from other Colleges, outside of the College of Engineering, expressed support of Division. It is the belief that if issues were brought to the attention from the Division, some assistance would be provided (i.e., reactive support). There is no evidence of active participation or contributions (i.e., proactive support), implying tacit support. The Division is perceived as an entity of the College of Engineering and thus not front of mind outside of this College.

Infrastructure

a) Are the College's human resources appropriate to meet its mandate and are they effectively and efficiently utilized? Does the Division have the right mix of faculty, staff, and HQP?

As described above, the Division has a 1/4 administrative staff position, whose main duties appears to be handling and processing of student files, and possibly assisting with the annual student seminar day. Given the number of faculty and students, the Division is under-staffed. This seems to have been also historically the case as the Division was previously supported by ½ administrative position when it reported to graduate studies before it became part of the College of Engineering. Consideration should be given to extend the role of support staff to help enhance the Division, such as facilitating effective communications between its members, including HQP.

The faculty associated with the Division appears to have good diversity, with representation on the Division's Executive Committee from multiple academic units. It may be prudent for the Division to consider representation on its Executive Committee, or a new structural interdisciplinary biomedical research committee from the Division Executive and key collaborators (e.g., VIDO, CLS, industry).

It is noted that the makeup of HQP are mainly derived from students with an engineering background. The mandate of the Division is to promote interdisciplinary research and be accommodating to students with varying backgrounds. Improvements with respect to this diversity should be examined.

b) Is the Division effectively and efficiently utilizing its resources?

The Division is provided with very limited resources and relies heavily on the resources of other academic units. In some senses this is extremely efficient, but the reality is that the Division relies on the goodwill of other departments which likely contribute everything from stationary to administrative support regarding student payroll. The program and its members appear to be spread thinly.

It is noted that the student space in the Animal Research building is apparently underutilized. It is not clear if this is indeed the case and if so, what can be done to improve the utilization of this space. The Division would benefit from some dedicated space within Engineering. This is both for relaxation, but also and perhaps more functionally important some shared workspace. If the program were to include a core class that students all took, perhaps this classroom could be dedicated for Division activities, and students could use the classroom for shared workspace when the classroom is unused. A classroom dedicated to the Division could be a multi-use room for student or faculty meetings, classes or shared workspace.

c) What are the strengths? What/where are the gaps (short, medium and long term)?

Strengths:

- 1) The Division members operate with a strong sense of collegiality and mutual cooperation. The members support the Division through giving their time and effort.
- 2) Similarly the Division is indirectly supported via the good-will of the home departments of the Division members. These two facts may be largely responsible for the long life and sustainability of the program, despite the very small amount of dedicated resources allocated to the Division.

The Research program of the Division is strong, with well-established imaging and tissue engineering, programs, and existing programs in rehabilitation, systems, instrumentation, materials, and growing programs in healthcare systems. Similar to most Biomedical Engineering departments the program is diverse and appears to be interdisciplinary.

- 3) Another strength is the potential growth available to the Division, given support and resources. The Division attracts high quality personnel, with biomedical engineering always being an attractive choice for graduate students. This will serve the Division well, but the students need support and community to maximize this potential.
- 4) Similar to the above, the ready access available to the Division to the health and veterinary related fields is an outstanding advantage at the University of Saskatchewan. Across Canada, Biomedical Engineering departments exist wherever there are both Engineering and Medicine, and seldom do all the Health Faculties, plus Dentistry and Veterinary Medicine exist within one center. The Division should strive to attract members from these diverse areas.

Short-term gaps:

- 1) The Division currently has an Acting Head, and will need more stable Leadership vetted through a proper search process. The search should be broad and full to best lay the foundation for the leader to guide the Division towards its strategic Directions.
- 2) The Division needs to identify concrete strategic Directions to consolidate its plans for stability and growth. That is, the new Head should engage the Executive and Division members in determining a few achievable strategic directions.
- 3) The Division needs to secure greater resources in their administrative support to put in place the capacity for building key elements needed to achieve the potential within the Division. The review committee felt there was the desire to achieve more with the Division, but the constraints on administrative time as well as faculty time for planning and growth were severely limiting. This support needs to be in place as soon as is possible so that the administrative assistant is there to help facilitate planning and implementation process for Division growth and renewal.

Medium to Long-term gaps:

- 4) The Division needs to address the lack of community experienced by the students. In the short term, they could consider changing, or better yet, supplementing the Annual Seminar Day with a weekly or bi-weekly seminar series led by the Division. Currently the students appear to only present yearly at the annual seminar event, which must mean

shorter conference style presentations. The Division should consider providing an opportunity for the students and visiting faculty to present in a more regular seminar series during the academic terms.

- 5) Further to building a sense of Community the University should seek a means to provide communal work and gathering places for the Division students. This is challenging given the demands on space within the College of Engineering, but perhaps if one classroom was always dedicated for Division classes/workspace this may provide a sense of home for the students.
- 6) The Division is recommended to work with the University and industry stakeholders to build capacity for the development of commercializable biomedical technologies and methodologies. This can include access to workshops, as well as identified support within the Research Services Office to address the particular needs of innovation in the Biomedical technology space. Knowledge and communication channels to experts in the areas of Medical Device Regulatory requirements and legal expertise for intellectual property protection and non-disclosure agreements as well as industry-academic contracts that support partnering are important aspects to encourage industry engagement with Division members.

Long Term Vision

a) Does the Division have a long-term vision that is consistent with the university's integrated plan?

The mission, goals, and vision, as stated in the self-assessment report appears to be aligned with University's *Promise and Potential* integrated plan; however, the self-assessment articulates itself in quite an abstract manner, without providing concrete short-term (and mid-term) objectives. As such, it is difficult to ascertain whether or not the Division is moving effectively within the University's integrated plan. The external review team believes that the Division currently lacks a solid plan to move forward. The review team recognizes that the Division recognizes this to some extent, and they want to achieve more. Thus the Division needs to establish such plan that is well-understood and well-accepted by its members.

b) Is the vision for the future significantly different from today?

As indicated in the previous question, this is difficult to assess given the lack of a concrete plan. The Division expresses a desire to become a more integrated and recognized unit, with increased control of its resources, and hence its operations and future. This desire is derived from a frustration of the status quo; however, the Division also needs to establish a strong aspiration to a clear objective, and the University needs to support the Division in its planning and implementation process.

c) Is the Division sustainable?

The Division has existed for half a century, despite the issues surrounding its structure. In fact, the Division has not only existed but appears to be productive and expanding. This has been achieved largely because of the strengths of the Division noted above and the support from the associated departments. However as noted this support is reactive rather than pro-active, and is not grounded in any firm operational or governance structure which makes this susceptible to individual priorities. The external review team believes that the Division is certainly sustainable but will remain stagnant and at risk unless it is restructured and given the resources and authoritative powers required.

It is noted that the Division is under a leadership transition, with a current acting chair, and a need to find a new chair. The external review team believes that the mandate of the new chair should include the establishment of a clear vision and objectives for the Division, along with an associated concrete plan and strong commitment from its members.