Meeting Minutes

Quantum NanoFab Users Advisory Committee: Inaugural meeting

Held: Tuesday, December 5, 2017 (1:00pm to 2:30PM) in QNC 1201
Committee members present:

Baugh, Jonathan
Cory, David
Kim, Na Young
Leung, Tong
Logiudice, Vito
Reimer, Michael
Safavi-Naeini, Safieddin (Ali)
Sciaini, German
Wilson, Chris

Regrets: None
Chaired by: Vito Logiudice
Minutes taken by: Melissa Floyd
Attachments: Vito's slide deck

Agenda proposed by Vito:

1. Infrastructure past & present: we've come a long way   (Vito)
2. Fab Operations: General overview   (Vito)
   a. Highlights from Fiscal Year 2016/17 & updates to Nov 30 '17
   b. TQT shared infrastructure: Benefitting from generous funding
   c. Financial update to end FY 2016/17
   d. June 2017 Lab User survey results
   e. Key objectives 2018
3. Discussion   (All)
   a. Questions
   b. Concerns
   c. Suggestions
   d. Additional items?

After welcoming and thanking all members for agreeing to serve on the Users Advisory Committee, Vito asked if anything else should be added to the agenda. All agreed to proceed as is.

Vito encouraged everyone to ask questions or comment throughout the presentation portion of the meeting.

1. **Infrastructure past & present**
   - No comments noted

2. **Fab Operations: General overview**
   a. **Highlights from fiscal year 2016/17 & updates to Nov 30, 2017**
      - No comments noted
   b. **TQT shared infrastructure: benefitting from generous funding**
      - Chris Wilson comments on slide 12 (Plassys UHV AL angle evaporator commissioning) that device commissioning activities are going well – tunnel junctions and aluminum resonators.
      - David Cory clarifies that RAC2 satellite labs are open to entire UW community, not just NanoFab.
      - Ali Safavi-Naeini asks if there are descriptions of the new machines available.
        - Vito mentions that all descriptions will soon be made available on the fab website.
   c. **Financial update to end FY 2016/17**
      - Jonathan Baugh asks if the CFI-IOF is renewable.
        - Vito mentions that we have approximately 3 years of funding left – discussions will have to be had in the future on how to eventually replace this important source of funds.
   d. **June 2017 lab user survey results**
      - Chris comments on slide 32 (areas for improvement): members of his group have noted some pushback from members of the fab team about user-owned glassware and space for these items in the fab.
        - Vito mentions that people have the option to use their own glassware. However, due to physical space constraints, the number of user-owned bins must be limited to that allowed by fab policy. Fab policy permits one 20-quart bin plus one solvent beaker bin plus one acid beaker bin per lab member.
      - Ali comments on slide 32 that there is a real need to expand working hours (Christmas Holidays, other holidays etc.) due to tight deadlines.
        - Vito mentions that keeping the fab open over the extended December holiday break will be difficult because the university is officially closed for this period and staff is therefore not available. Furthermore, this particular extended break is used by a 3rd party contractor to complete the annual high purity water loop sanitization. High purity water is not available anywhere in the cleanroom or throughout the QNC building over this 3-day period.
        - Vito also mentions that lab members with Advanced Equipment User credentials may use all available tools during other short holidays such as Thanksgiving, etc. Vito described the requirements to be met for obtaining *Advanced Equipment User* status: 150hrs of independent equipment use & no access suspensions in previous three months.
      - Tong Leung asks how we are dealing with the cancelled booking issue.
        - Vito mentions we are trying to address it with the multiple reservation rule options made available through Badger. Currently, if people cancel their

bookings outside of 24 hours they can cancel no problem. If it's within 24 hours, they cannot cancel the booking themselves but must ask staff to cancel it for them. Some of the most heavily used tools have been assigned Badger rules which limit the duration of a single reservation and the total number of hours that can be reserved by a user over a 2-week period.

- Tong asks if users are charged for a booking cancelled within 24 hours.
  - Vito confirms they are not.
  - Vito explains that we recently implemented a new rule for the Raith EBL that limits the 14 hours of total time each user is permitted over 2 weeks by the duration of their reservations which have been cancelled inside the 24 hour limit.
  - Vito mentions that the problem is limited to a handful of people and that performance typically improves after Vito addresses the issue with the lab member directly.

- Vito opens the discussion for ideas on how to address booking cancelations:
  - Na Young Kim: heavy use machines – at Stanford they had a user list that could be emailed if there is a last minute cancellation so that someone else could use that time. Vito asks if people subscribed to tool-specific mailing lists. Na Young confirms yes: if you are a qualified user you could subscribe to that tool's mailing list which was used to announce last minute equipment reservation cancellations. The list was also used as a store of knowledge for users of that tool. Vito shows an example of a tool-specific auto email that Badger currently generates and wonders if there are some parallels with Stanford's system; it appears there are.
  - Na Young suggests that for heavy use machines we can shorten the cancellation window.
    Action Vito: Explore this suggestion in 2018, especially now that fab use has grown significantly.
  - Chris suggests we start charging people for short timeline machine cancellations.
  - David suggests that we need to think this through given funding sources such as TQT and IQC that currently subsidize fab access costs for several faculty members.
  - Chris mentions that bad behaviour costing money is more of a deterrent.
  - Ali suggests a black list of bad behaviour. Vito mentions that we have maintained such a list since 2012 but it is confidential and accessible by fab staff only.
  - Na Young: if it's a cancellation fine it needs to be defined as such on the invoice so that PIs can address this with their student.
  - Vito asks the committee about implementing a cancellation charge. The consensus is that it's fine if it's specifically defined on the monthly invoices. Tong suggests that the PI may want to dispute these charges because it's the student's fault and that the shaming method does work for the most part. David suggests that the Advisor should be the one having the discussion with the students instead of Vito – billing the advisor will encourage the advisor to have these discussions and that such an approach

will be helpful if it is perhaps applied only to the fab's most widely used tools such as the Raith. Jonathan suggests that an email going out from the same student over and over again will help deter short time cancellations because it will reflect badly on the student. Chris wants us to motivate the advisors. Vito says that speaking with the individual does work until a new wave of users comes through. Vito suggests that a combination of emails and cancellation charges on high use tools might work. German suggests that users should have a set number of cancellations per year and when they exceed it there would be consequences – add this to the invoice so that PIs are aware. Chris asks if cancellation charges could be appealed if it is reasonable.

Action Vito: Great discussion and suggestions. Explore the application of some of these suggestions in 2018.

- German mentions that the ReynoldsTech spin coater hood is equipped with two sets of spin coaters and hot plates and wonders if half the hood can be booked to minimize the bottleneck at this tool, but he isn't sure about sharing because of messy people. Vito says that we did configure that tool as two separate bookable tools when we operated out of the RAC1 cleanroom between 2009 and 2013. This did not work out well because different people work with different standards and that particular setup was therefore a nearly constant source of grief for users. Vito mentions that one of the Brewer spin coating hoods will be released for use in January which should help address the existing bottleneck.

- German asks if it would be possible to add a thickness monitor to the Intlvac e-beam evaporator so that the deposition thickness can be monitored in real time. Currently, Ariel in German's group is having a difficult time consistently meeting their deposition targets which are on the order of 10nm to 25nm. Vito mentions that there is a crystal monitor on the tool for deposition rate calibration but is not certain if it is active during the deposition itself. German is also not sure. David mentions that German should send Vito and David an email with what he thinks would be useful to address his requirement. If new tooling is required then TQT funds might be available to cover the upgrade cost.

  Action German: Send an email to Vito/David describing what hardware might be required on the Intlvac.

  ◦ Na Young asks if the crystal output is accurate and mentions also that the subsequent use of a stylus profilometer for measuring film thickness is not necessarily always accurate. Jonathan says that accuracy is to within approximately +/-10nm. Vito mentions that ellipsometry is the best way to test the thickness of very thin (and thus likely transparent) films on the order of a few nanometers.

  Action Vito: Explore Intlvac options after hearing from German.

- German thanks David & Vito for the maskless aligner.
- Ali asks (slide 33) what kind of capability the semi-automatic wire bonder has. Vito says that the semi-automatic unit is currently configured for aluminum wedge bonding and the manual wire bonder is currently configured for gold ball bonding.

e. **Key objectives 2018**
- Vito notes on slide 34 that we will add the cancelations issue under the "general" key objectives for 2018.
- Chris would like to drive home the point to the students that with chemicals, cleanliness and safety are one and the same. Vito mentioned that he is in complete agreement.

3. **Discussion**
   a. **Questions**
   - German inquires about the quick growth of the member base: what is the capacity of the team/fab? Will the growth at some point become negative to users?
     ◦ Vito: on the equipment front – the major important tools (Raith EBL, JEOL EBL, entire Oxford suite of tools) are all on service contracts which will thus help address the increased wear and tear caused by increased tool use. We do have some limitations however when these unique machines go down which create bottlenecks (PECVD, ALD, both RIE's and Intlvac are all unique tools in the fab). In terms of personnel, the situation has been strained over the past few months but the addition of a new characterization scientist (thanks to TQT funding) in the new year will definitely help. Once this position is filled and Lino returns from parental leave, Vito thinks that we will have the capacity to absorb more usage since the team's capacity to train new and existing users will be greatly enhanced.
     ◦ German asks if Vito knows how many hours are being billed by the University of Alberta's Nanofab. Vito says that that info does not appear to be publicly available.
   - Ali asks if we should drive the direction that the lab is going based on who needs a tool as well as which tools are used most when it comes to future acquisitions.
     ◦ Vito: shows fab website and annual reports – see FY 2015/16 Annual Report: Hours Enabled (billed) per tool (page 12):
       https://fab.qnc.uwaterloo.ca/data/annual-reports/fy2015-16

     ◦ Ali asks if we use this criterion when contemplating what tools and resources should be added. Vito says that we do look at usage trends combined with reservation efficiency data when looking at buying new machines. We take the approach that is routinely taken in industry before justifying the addition of a new tool, which is to identify if the existing tool is efficiently used (with minimal reservation cancellations) and whether its uptime remains good (with few breakdowns). Before the notion of acquiring a backup tool is considered, we look to first improve equipment use efficiency and to maximize its uptime.

- Ali asks if we have a strategy/vision for the lab's future expansion. Do we look at what PI interests are or do we have a specific growth focus in a particular field? Are we trying to promote or emphasize certain areas?
  - Vito: from our perspective every research-intensive university such as ours must have a core lab infrastructure which serves well the nanofabrication needs of the university's many researchers from across multiple disciplines. The Quantum NanoFab's tremendous growth in use over the past two years is testament to its growing importance to a large number of researchers from across campus. The fab's core capabilities must never be compromised by attempting to satisfy or implement too many potentially incompatible or rarely used processes in this one lab. We must continue to strive to do what we do best, and to not place the fab's existing capabilities at risk via the introduction of potentially damaging new processes or processes that will serve only a very limited research base. If a highly specialized capability is introduced that is of interest to only one or two researchers, experience suggests that the affected tool(s) will likely not be used frequently enough and will thus eventually fall into a state of disrepair. Or, the researcher's ability to modify the affected tool or process might be limited by the fab's open-user mandate. In the case of such specialty processes, it's best for the researchers in question to keep these capabilities in their private research labs so that they may exercise full control over these and retain full flexibility to the overall benefit of their focused research program.

    Alternatively, if a solid case can be made for the addition of a new fab-compatible capability that will benefit multiple research groups then of course it makes sense to consider this new addition. Clear boundaries must always be maintained however as to what should be permitted in the lab to avoid the introduction of new processes (such as bio-processing for example) which will compromise the fab's integrity to the detriment of the facility's entire membership. If new, incompatible processes are of interest to a large community of researchers, a case can perhaps be made and protocols developed for the implementation of a dedicated satellite lab outside the cleanroom which will house these incompatible processes and thus preserve the integrity of the QNF's core cleanroom lab.
- Chris: some of the tool use costs don't seem to match well the true expected upkeep cost of some pieces of equipment (fume hoods for example). Instead of billing for every moment of the wetbench or microscope could there be a general charge for entering the cleanroom for the basic tools which everyone uses? We should perhaps review how certain things are billed to increase efficiency for lab users so that they don't have to enable/disable the microscopes in Badger continuously for example.
  - David mentions that we need a vision for future staffing levels and service contracts to ensure the fab's sustainability. These considerations need to be addressed in any such discussions.
  - Vito mentions that we have been working on capturing the cost of operations on a per-tool basis via the fab's TRAX SW platform. It will now

be possible in the new year to cross reference per-tool use costs with per-tool usage statistics and thus adjust the tools' hourly access rates.

- ◦ David suggests that the existing approach of having to sign into each machine enables us to see who is responsible for breaking a machine so perhaps this is not the best way forward.
Action Vito: Add this as a subject for the next Users Advisory Committee meeting.
- ◦ Chris would like to reduce friction and distraction associated with having to continually sign in and out of tools.
Action Vito: Explore this in the new year after per-tool cost of operations have been calculated. Perhaps the cost of use of some of these frequently used tools (such as microscopes for example) might be reduced to a level low enough to allow a user to book the machine for longer periods of time without incurring excessive equipment use fees for the tools in question.
- Na Young would like to address the question of how to prevent misbehaviour.
  - ◦ Vito says that this is often the product of new, inexperienced members, and seeing others behave badly and doing the same thing. Bad behaviour appears to come in waves. Colleagues at other universities across North America suffer through the same issues. What's crucial is that we not allow a culture of misbehaviour to take hold, as this will impact the fab's ability to maintain excellent operations.
- Tong would like to suggest an idea for the next meeting: come up with some mechanisms for users to share their knowledge with other users.
  - ◦ Vito asks for clarification: a user could share their process and/or knowledge if they are willing? Tong and Na Young agree that this is what they are after.
  - ◦ Na Young says it could be voluntary and could be very useful for growing knowledge.
  - ◦ Vito mentions that when he is speaking with new members at orientations, he encourages them to share their experience with their colleagues.
  - ◦ Na Young says that these emails are archived for later use.
  - ◦ Ali says that CMC has a kind of "social networking" to share information which has been quite useful.
  - ◦ Vito asks for clarification: are we looking to create a mailing list? Vito puts the question to the committee to come up with ideas on how to implement this idea of knowledge sharing. Vito says that our mailing list is moderated and could be used to help facilitate this. Others suggest that the fab's existing mailing list is not ideal for this specific activity. Per Na Young's suggestion of a mailing list per tool, Vito agrees that we could perhaps create such mailing lists for people to sign up for if they want to be part of these sub-communities (for instance a Raith EBL user community mailing list).
  - ◦ Tong suggests that when a new user is trained on a new tool that they state what their project title and process is so that people could contact them about it.
  - ◦ Vito suggests that the primary trainer for this tool could moderate the list.

- ◦ Na Young suggests that these conversations could be archived so that users could search old comments.
    Action Vito: Great suggestions. Discuss the possibility of creating tool specific mailing lists internally and look into implementing some version of this in the new year, starting with the most frequently used tools (Raith & JEOL EBL systems for example).

b. **Concerns**
- No comments noted

c. **Suggestions**
- No comments noted

d. **Additional items?**
- No comments noted