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# Post-Occupation Evaluation Study Report

Project: S-Lab: Chemistry Building, University Park

Date: May 2017

BUILDING UNDERSTANDING

# TABLE OF CONTENTS

# INTRODUCTION

In January 2017, Building Understanding submitted a proposal, to the University of Nottingham Estates Department, to conduct Post-Occupation Evaluations. The proposal was accepted. The S-Lab project is the first project to be evaluated by Building Understanding.

This report details both the strengths and the learnings drawn from the S-Lab project, and puts forward recommendations that can be applied to future projects at the University of Nottingham.

There are many positives associated with the S-Lab project. First and foremost, the project succeeded in delivering a state of the art teaching facility, far superior to what had previously existed, on time and on budget, despite a compressed and highly challenging programme.

S-Lab can be credited with stimulating changes in the way that chemistry is taught at the University. It has created cultural changes in the way that University departments and faculties collaborate and has empowered the laboratory technical staff by extending their roles.

While feedback about the finished S-Lab was overall extremely positive, as with every project, there are issues to report. It is the learnings, gathered as part of this study, that make up the main body of this report, many of which have their root in the project's restricted time envelope.

# PROJECT BACKGROUND

S-Lab is located on the 3rd floor of the Chemistry Building on the University Park Campus, at the University of Nottingham. S-Lab has replaced a dark, old fashioned laboratory space, which was no longer fit for purpose. Last refurbished in the late 1980s, the original lab space was in a traditional style, with parkay flooring and teak benches. The approach to the lab was a narrow corridor with several small offices along its length, making it a confined space.

Laboratory space across the campus had become an issue, particularly for the School of Engineering, and this had necessitated multiple rotations of groups of about 20 students, which was costly. Further, changes in the way that multidisciplinary science is taught meant that revisions to the infrastructure were necessary.

A University initiative, led by the UEB (University Executive Board), was examining ways of addressing the problem of teaching spaces that, because they were equipped to meet the needs of a specific group of students, are only used for a small percentage of time and for the remainder, lie vacant. This project represented an opportunity to create a fully adaptable science teaching space that could be made available, not only to the School of Chemistry, but also to other schools within the University of Nottingham, as well as summer schools and schools outreach projects.

The vision, for the S-Lab project was to create a functionally adaptable, open plan laboratory which utilised as much natural light as possible, in which all students, including those with special requirements could work alongside their counterparts. The internal client, the School of Chemistry, played an integral role in the project. Key individuals from within the School of Chemistry, spent time visiting universities across the UK, drawing on what they learnt in order to develop the lab.

The project programme was tight and this was driven by the need to start teaching in the lab by 26th September 2015. This date was 'set in stone'. At the opposite end of the project process, the commencement date was restricted by the meeting of the finance committee to agree the use of HEFCE funding for this project.

**"Pictures of the lab, before and after, speak for themselves. The space, and how it's laid out, was dark and dingy and there wasn't much light in there. You can't believe that you're in the same building."**

**"The overall success of it was getting the students in on time at the start of the new academic year; albeit not everything was 100% working at that time."**

**"Other institutions are taking elements of the STEM lab, Birmingham, in particular. So, it has gone to the wider community.**

# OBJECTIVES AND METHODOLOGY

## OBJECTIVES OF THIS POST-OCCUPATION EVALUATION

- To bring to light any key issues associated with the building procurement process and management of the development project
- To draw out stakeholder feedback concerning the design of the building and the experience of its end-users
- To facilitate a half-day workshop, to discuss and debate the key issues revealed through the primary research
- To analyse all output from the face-to-face depth interviews, online questionnaires and the workshop to provide a summary report with recommendations

## SCOPE OF THE STUDY

Building Understanding sought feedback on the following aspects of the S-Lab project:

- Overall user satisfaction
- Satisfaction with the lab space
- Design issues
- Security
- Accessibility
- Cleanliness
- Air quality
- Internal room temperature
- Distraction from noise
- Lighting conditions, natural and artificial
- Data connectivity at the workspace
- AV equipment in the teaching/lecture rooms
- Budget and cost management
- Heating and cooling
- Construction issues and cost
- Mechanical and electrical services
- Sustainability
- Operations and facilities issues

## STUDY PARTICIPANTS AND METHODOLOGIES

Building Understanding conducted face-to-face interviews and distributed email questionnaires to respondents. Five different questionnaires were prepared in order to canvas feedback from respondents drawn from the following categories:

- Consultant team
- Contractors and specialist suppliers
- End users of the facility
- Estates office staff
- Internal client

### The workshop

On Monday 15th May 2017, a workshop took place involving 21 attendees. The workshop objectives were to:

- Discuss and debate the SWOT analysis gleaned from primary research
- Generate recommendations to be applied to future projects commissioned by the University of Nottingham

The workshop commenced with a presentation by Building Understanding, of the SWOT analysis. Weaknesses and threats were then debated. Attendees were divided into breakout groups, with each group charged with assigning recommendations to specific points of feedback.

A list of the workshop attendees is detailed in Appendix II.

## SAMPLE SIZES

It is important to emphasise that the quantitative statistics in this report are based on very small samples. A total of 19 respondents were approached for feedback and, of these, individuals 15 responded. As questions varied by respondent group, the sample sizes are very small.

# S-LAB PROJECT DATA

| | |
|---|---|
| **Name of facility:** | **S-Lab** |
| **Location:** | Chemistry Building, 3rd floor |
| **Gross area:** | 600m2 |
| **Number of storeys:** | One |
| **Users of the facility:** | Chemistry & Engineering Students – 150 Occupancy |
| **Room types:** | Laboratory, preparation rooms, break out room |
| **Start on site:** | May 2015 |
| **Date completed:** | 23rd September 2015 |
| **Period on site:** | 16 weeks |
| **Gross project cost:** | £4.2Million |
| **Funding:** | HEFCE |
| **Contract type:** | JCT with Contractor Design |

### Key features of S-Lab

- Multi-disciplinary and adaptable space
- Moveable benches and services
- Glass-backed auto-sash, fume cabinets
- Booms
- Vacuum system

# ACHIEVEMENT OF OVERALL OBJECTIVES

Overall, the responses to this post-occupation study indicate that the project has been a resounding success. The S-Lab project has achieved its core objectives and has created a facility of which the University of Nottingham is justly proud. Despite a highly challenging time envelope, S-Lab was delivered on time and on budget.

S-Lab is not just about bricks and mortar. It has allowed and facilitated far-reaching cultural changes in the way that the schools and faculties collaborate, changed the way that chemistry is taught at the University of Nottingham, and enhanced the way that lab technicians now work.

The extended team deserves credit and recognition for the positive way that they worked together to achieve the date set for occupation.

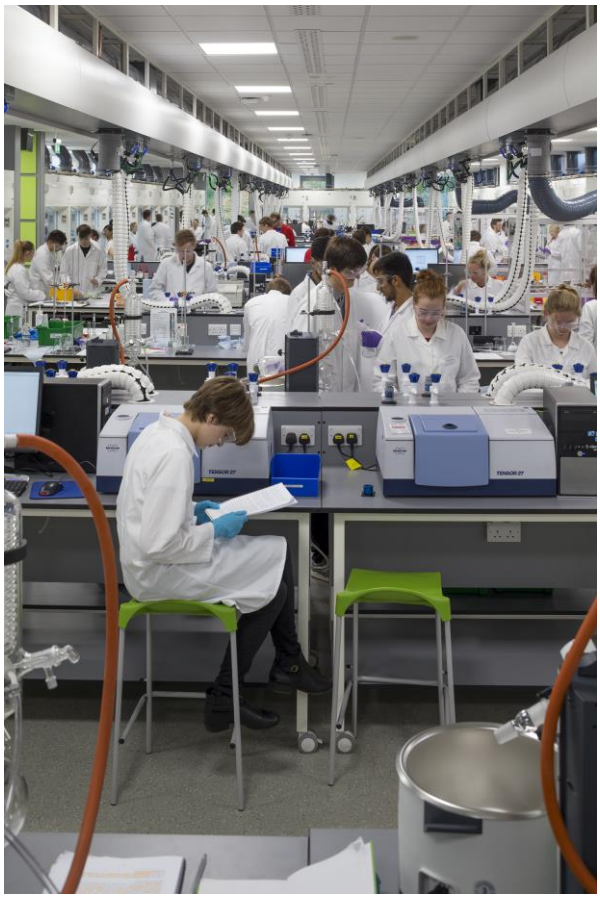
**"It was great having people who are hands-on and know how the lab works. While we don't know how the process works, we understand what they need to achieve."**

Key achievements highlighted through this study are:

### Delivery of the vision

The Lab has an open feel, achieved through the large airy space, abundant natural light, clear back fume hoods, choice of colour and good line of sight. This environment is a stark contrast to the dark oppressive feel of the old laboratory.

The provision of services from above, via the booms, and also improved storage within the space, makes the laboratory neater.



### Efficient use of teaching space

S-Lab was handed over in September 2015 and has been in full use ever since. The lab is used primarily by the School of Chemistry but it is also used by the Schools of Biology, Engineering and Geography. In fact, the S-Lab project can be credited with helping to change the way that the schools and faculties within the University cooperate and collaborate towards the more efficient use of space.

**"It has enabled us to take 100 to 150 students at once which is quite a logistical nightmare but the teaching technicians are able to do that. We are also able to accommodate other student bodies from across the university."**

**“It has allowed everyone an element of freedom to learn science in a wonderful new environment.”**

### Respondent satisfaction

Satisfaction with S-Lab has been evaluated from the responses given through the face-to-face interviews and the email questionnaires. Quantitative ratings are displayed in the diagrams in Appendix I.

### Improving student experience

The internal clients and users of the facility are delighted with the outcome, believing that S-Lab has had a highly positive impact on the student experience. The functionality has made the space easy to work in and a pleasure to be in.

The design of the space makes it easier for students to work. The new benches are deeper than ones used previously, giving students more working space, and with equipment on trollies they can locate themselves wherever they need to work. Enabling them to work alongside friends has improved the quality of their experience

Fume hood services are identical in each side of the fume cupboard meaning two students can work in the same space, without having to share sinks and nitrogen lines.

**“S-Lab has far exceeded our expectations. The student feedback has been absolutely excellent.”**

**“Having toured the UK looking at laboratories I still have yet to see a better example of a teaching facility capable of serving 150 students.”**

### Adaptability

S-Lab has fully achieved the objective of adaptability. The configuration of the space can be changed completely, over a lunchtime, to best meet the needs of students in the following session.

**“We, on the design side, were somewhat dismissive of that because we have put in adaptable, flexible systems before. Within about two months of handing the lab over, I walked in one day and all benches had rotated 90 degrees. That was remarkable because I didn’t think they would do that and they have done it and they have continued to do it.”**

**“One of the most successful elements, for me, is the ability to change the space to meet our teaching needs, whether it is for chemistry or engineering or for whoever we bring into the at space. Not just for undergraduate teaching. It gives us the overall freedom to design and develop.”**

### Cultural change

The ability to accommodate larger groups of students has made teaching more efficient. Furthermore, the adaptability of the space is changing the way that chemistry is taught at the University. Changes in the way that the laboratory team operates as a result of S-Lab have resulted in better working relationships with students. Previously, the technical staff were largely located in the prep rooms, with cleaning or stores roles. Thanks to the physical changes to the lab, all technicians are now more visible to students, providing more hands-

on support. They are developing both their roles and their skills within this new setting and have relished this increased level of responsibility.

**“S-Lab has transformed our way of working for the better. The design has meant our team are now in the lab with the students, full time, so better working relationships have been formed. The new facilities in the lab have pushed us to completely rethink our delivery of the practical element of the classes, which has motivated everyone.”**

**We have nominated the whole technical team and the senior technician for a Papin Prize this year. That is for outstanding delivery of technical teaching.”**

### Adaptability for disabled students

The ability to adapt the height of some benches means that disabled students can also work alongside their cohort.

### Room types

Once a narrow corridor with a row of small offices, the breakout area now provides useful space to hold tutorials and for students to work or relax between classes. It is regarded as a real benefit by students and teaching staff alike.

**“The room types have added an extra functionality to the space. It has worked perfectly. The break out space is being used for tutorials, which has given us some extra functionality. It wasn’t our idea to do the break-out room, it was an idea from Estates. It has been very well used.”**

### Ease of cleaning and maintenance

Overall, S-Lab is considered to be easy to keep clean and to maintain.

**"The design of the lab makes it very easy to maintain, it is the way it is set out. Labs are usually quite difficult but this is OK. On basic day to day cleaning it is very good, and better than usual."**

## Attracting potential students to the University of Nottingham

Two respondents from the Department of Chemistry commented on the impact of S-Lab on potential students visiting the University's Department of Chemistry. In terms of undergraduate recruitment, first year chemists have increased from 171 in 2009/10 to 257 in 2015/16.

**"I have actually seen comments by students after UCAS days saying, 'wow what a fantastic place to come and study'. It has had an impact to the point where we increased our first-year intake."**

## Innovation

S-Lab is considered by respondents to be highly innovative in a number of ways including the adaptability of the space, delivery of services via the booms, energy usage, BMS and mechanical controls, the audio communication system and by creating a paperless environment. Testament to how the Lab is viewed in the wider academic arena was that in September 2016, Nottingham University hosted the S-Lab conference, which was attended by architects and project managers from other UK universities keen to learn about the S-Lab.

The delivery of services through the booms has made the lab tidier and the glass-backed fume cabinets contribute to the light and open feel of the space. The cabinets also facilitate the teaching of students, allowing people to observe from all sides of the cabinet.

**"The space has an audio system in so that we can communicate directly with students and both the technicians and the academics can access the audio system through the lapel microphone. It has completely changed how we deliver things."**

Innovation was also demonstrated in the way the lab was fitted out. The lab equipment supplier responded to the tight time schedule by changing their process. Rather than assembling the laboratory furniture on site, as usual, they assembled items such as the mobile benches in a rented facility and delivered them to site ready-built.

# QUANTITATIVE FEEDBACK

Quantitative satisfaction ratings were collected during the face-to-face interviews and through the emailed questionnaires. Respondents were asked to rate their satisfaction with various aspects of the S-Lab project on a scale of ‘one’ to ‘ten’, where ‘one’ is very poor and ‘ten’ represents excellent.

Bar charts displaying the percentage split by rating, are shown in Appendix I. It is very important to emphasise that these quantitative results are drawn from very small samples and are therefore not statistically significant. What they do show, at a glance, is the high level of satisfaction with the S-Lab project across the project.

Key findings include:

When asked the question ‘How satisfied are you that the outcome has met your expectations?’ 100% of respondents rated either ‘nine’ or ‘ten’.

More than 65% of respondents rated their ability to access to the site at ‘ten’. This reflects the willingness of the contractor to make this possible.

The lowest ratings were received in response to the question regarding the overall quality of S-Lab. Dissatisfaction with the experience of dealing with the supplier of the vacuum system is reflected in responses to the question concerning satisfaction with subcontractors and suppliers. For both of these questions, 50% of ratings were of ‘eight’ or below.

When asked about their satisfaction with the security of the lab, 50% gave a rating of ‘seven’. Once again it is important to emphasise that this was a very small sample.

In the response to the question regarding satisfaction with features and equipment, 40% of those asked gave a rating of ‘seven’.

# QUALITATIVE FEEDBACK -THE DESIGN AND THE CONSTRUCTION PHASE

**“There are things we see that could have been so much better for no cost, for almost no effort, other than consideration.”**

This section details the learnings gathered from feedback concerning the design and construction phases of the project, with key areas for improvement falling into the following categories:

## FEEDBACK RELATING TO THE AVAILABILITY OF INFORMATION

### Lack of building survey information

There was a lack of building survey information for the Chemistry Building, as there is, generally, for University of Nottingham buildings that pre-date the 1990s. According to respondents, building survey records held by the Estates Department are limited and often, only room layouts are available. The consequence of this on the S-Lab project was that during the operations phase of the project, a sheer wall was discovered, the removal of which had a significant impact on the programme.

As it is difficult to conduct intrusive surveys in a live teaching environment, there was widespread agreement that there is no quick fix for this issue. In the longer term, however, the issue will be ameliorated as thorough records are kept from the newly constructed buildings at the University.

However, there is an opportunity to gather information and photographs pertaining to the building structure from the occupants of the building and from the Estates department.

#### Recommendations

- Discover whether members of the department occupying the building have, on file, any information regarding the building.
- Keep the records from previous modifications and newer buildings up to date and make them easily accessible for future projects.

### Lack of information regarding specific I.T. equipment

While not considered a major issue, towards the end of the operations phase, there were some delays in obtaining information regarding I.P. addresses and about the configuration of equipment on the network. This problem did delay the commissioning of the devices and was a consequence of the rushed final phase of the project resulting in communication issues between IS, project team and the equipment provider.

#### Recommendation

Ensure that all information required for the installation of devices is provided to the I.S department at the correct juncture.

## ISSUES RELATED TO THE PROGRAMME

The key requirement to deliver S-Lab in time for the arrival of students on 26th September 2015 was achieved. However, the pace of the programme had consequences, with the following issues being highlighted throughout this evaluation:

### Programme not sufficiently detailed

There was a detailed programme in place prior to starting on site, however, once on site, with a fast-paced project and the unexpected sheer wall, the programme became less detailed as the project progressed. The discovery of the sheer wall created particular issues because it meant an already tight timeframe was even tighter and resulted in the programme appearing to be playing 'catch up' with what was happening on site

Similarly, due to the tight timeline, it was not possible to update all the drawings and circulate them to all parties. In future projects, here is a need to factor in the time to check drawings with the end users, and to get the drawings signed off throughout the project.

Combined with the tight timescale, the project took place over the summer period, which exacerbated time pressures, particularly for the sourcing of equipment from Europe.

#### Recommendation

- Build more lead-in time, into the project, to enable the contractor to plan the project sufficiently, circulate the drawings and to allow for the time it takes to obtain equipment that is manufactured abroad.

### More time needed for sign off on the specialist services

One of the key learning points arising during the project was the need for a greater time-allowance for the internal client to sign-off on the specialist services. Through no fault of their own, the internal clients did not have sufficient time to examine designs and either suggest changes or give approvals. In many cases, due to the tight timescales the construction team needed to proceed on assumptions, having to revisit items and make changes at a later date.

One key area where the issue of sign-off had particular repercussions was with the vacuum system, which is essential to the functioning of any chemistry lab. This is a highly-specialised service and it was important to get the specification exactly right.

The requirements for a vacuum system vary depending on which discipline the user is from. It is therefore important to understand exactly what is required by all potential users of the lab and to have total clarity on the expectations from both sides. In this project, there were lots of conversations taking place about the vacuum system but they we not well linked. The department did see specifications but they were not articulated using a common language.

Coupled with this, the supplier of the vacuum system led the University to believe that the vacuum that had been specified would meet the department's needs, which, once installed, it unfortunately failed to do. Issues with the vacuum system have at last been rectified as a result of utilising the expertise within the university, however there has been a considerable additional cost attached to this.

**"We tried to do it as rigidly and in as structured way as possible from an early stage but because there are so many different things that need their buy-in and approval some of it did start to falter as we got into the construction period."**

**"We had an issue with the vacuum system, which was a totally bespoke system and it has taken us a while to get that correct. We had high expectations but a low level of knowledge of how to achieve what we wanted. It did not meet needs. It has now been rectified post-delivery."**

### Recommendations

- Ensure that sufficient time is 'ring-fenced' to give end users the opportunity to finally sign-off the specification.
- Tease out the brief in discussion with the internal clients, to understand specific and exact requirements.
- Draft a specification and ask all parties to review it.
- Talk to multiple suppliers and ensure that there is clear understanding of whether they can meet the specification in full.
- Once the contractor is on board, ensure they understand the specification and explain what is required to the party that will be installing the system

## Testing of equipment

Due to time limitations, there was no opportunity to carry out robust testing of key equipment, such as the fume cupboards, before the lab went 'live'. This resulted in teething problems in the early part of the operation of the lab.

Recommendation

- Allow sufficient time to ensure that thorough testing of all equipment is complete.

## FEEDBACK RELATING TO COMMUNICATION, COLLABORATION AND PROGRAMME MANAGEMENT

### Coordination of Mechanical & Electrical services

The lack of coordination of the mechanical and electrical services was one of the key issues emerging in this PoE study. This lack of coordination exacerbated an already tight timescale, as trades were, on occasion, unable to complete planned operations due to other pieces of work taking place.

The workshop participants felt that for projects where mechanical services are as complex as they were for S-Lab an M&E coordinator role should be specified. The group felt that what failed on this project was the management of all of the specialist services because there were so many trades operating in one area.

**"The mechanical engineering overseeing role is something we would change, and we have tried. We are doing some tenders for another university at the moment and they have said 'what else do you think we should put in the PQQ' I have said 'as well as a design manager we need this individual otherwise it will go to pot'."**

**"With a bit of thought, more time to sit different suppliers down in a room together and get them to collaborate on how they were installing stuff, you would get a far better job for zero cost. Everyone is still doing the same thing, with the same materials, they are just doing it so they are not messing up for the next guy to come along. It's back to the programme and time."**

#### Recommendations

- The role of dedicated M&E coordinator will be written into future tenders on complex jobs.
- The CV of the individual proposed for the role should be provided, as evidence that this individual exists and has the required experience. They should also be available for interview during the tender process.

### Handover

Considering the time pressures, the handover was well received, with the extended team working closely together towards a common goal. The success of the handover is a testament to the positive attitude of the extended team.

Due to an extremely tight timescale and contractors working on the lab until the opening day. The lab team was originally allocated a four-week fit-out period, but this was condensed down to just a weekend and the first classes held in the lab were treated as a test. For example, the design team and the engineers were monitoring the air balance and the functioning of the various systems whilst the students were in place. There were a number of teething troubles on the first day, for example, the sinks leaked as result of sink traps not being tightened

While the first live teaching session was taking place, there were press and photographers present, which was agreed to be unfortunate timing.

Finally, the speed of the programme impacted on the timely delivery of O&M manuals.

**"O&M manuals are what we use as reference so if something fails we have to pick the phone up rather than referring to the manual. I would say on all projects it's about getting better quality and delivery on the O&Ms. To have those things in my hand when you get the keys to the door would be handy."**

### Recommendations

- Make a member of the maintenance team available on the first day of operation, to check basic things, such as the tightening of the taps.
- Talk to the University media office about taking care not to admit press and photographers to recently completed projects on the first day of operation.
- Ensure that the O&M manuals are delivered, in full, on time.

## FEEDBACK RELATING TO DESIGN AND CONSTRUCTION ISSUES

S-Lab is a very services and end-process driven design, which created some challenges for the design team.

Due to the time pressures, the design was coordinated while the project was out to tender and a raft of variations issued afterwards. This situation introduces cost uncertainty and put the contractor under additional pressure.

Due to the specialist nature of the facility, some of the requirements within the lab were challenging from a design perspective. Elements, such as the vacuum system and fume cupboards, needed to be developed through three or four iterations. There were different types of fume cupboards within the lab and, because of the lead time, they had to be procured separately.

### The location of the chemical traps

The chemical traps or catch pots, which need to be emptied regularly, are located in the plant room, which is in the roof space. Given that the combination of chemicals captured can be so varied, there is a potential danger from inhaling the mixtures when emptying the pots, as there is no extraction in the plant room.

The control panel in the ante room is broken and does not alert staff when the catch pots are full. Going forward, the lab team feels that it would a safety benefit if all the catch pots were located locally, in the ante-room of the lab so technical staff are able to monitor what is collecting in the pots, empty them regularly and easily in order to prevent the accumulation of hazardous mixtures.

Recommendations

- With immediate effect, place a COSHH label on the door of the plant room to direct people to take the required safety precautions or contact a specified individual for assistance.
- Check with the supplier why there is no warning light showing on the control panel, to signal that the traps are full.
- Ensure the catch pots are checked every day because of the potentially hazardous mixtures.
- A robust local procedure for maintenance (PTW) permit to works should be put in place.
- Investigate the possibility of relocating the pumps and catch pots to the ante room.
- If the catch pots cannot be relocated, consider installing a camera pointed at the catch pots or a meter to monitor the contents.

### Suitability of spaces for teaching larger groups

Discussion during the workshop revealed that, while the space works well for teaching groups of around 100 students, it is a little 'tight' when a group of 150 students.

Also, the storage areas in the lab are a little too 'claustrophobic' and it may be a good idea to replace the outward opening doors with sliding doors. Screening was also highlighted as a possible way to hide the storage area, which can often look untidy, and so improve the look of the area.

**"There was a little too much pressure on hitting x number of people and x number of fume cabinets. There are areas and space allowances in that lab we personally consider are too tight."**

### Recommendation

- For future projects, look closely at space requirements where large groups need to be accommodated.
- Consider replacing the doors on the storage cupboards with sliding doors.
- Consider providing screening for the storage area close to the lab entrance.

## FEEDBACK RELATING TO SUSTAINABILITY

Although there are features, such as specialist glazing, water usage and LED lighting that will have had a positive impact on resource use, there is currently a lack of data to enable us to assess the Lab's success in terms of its sustainability, as part of this study.

One respondent noted that the number of fume cupboards is high and that steps should be taken to mitigate their energy consumption. These suggestions are detailed in the recommendations below.

**"The CNL Building (GlaxoSmithKline Carbon Neutral Laboratory for Sustainable Chemistry) had a dedicated consultant on board to make assessments of that."**

### Recommendations

- Consider adding variable volume drivers to fume cupboards.
- Switch fume cupboards off totally overnight.

- Keep chemicals in ventilated cabinets overnight, rather than storing them in fume cupboards.
- Follow the example of the GlaxoSmithKline Carbon Neutral Laboratory for Sustainable Chemistry and use a consultant to assess the cost/benefit of adding sustainable features.

# QUALITATIVE FEEDBACK - POST-OCCUPATION ISSUES

## FEEDBACK RELATING TO THE QUALITY OF THE INTERNAL ENVIRONMENT

### Air quality

The air quality is considered to be a considerable improvement on the previous laboratory.

**"It is the most well-balanced synthetic laboratory that I have ever been in. The airflow is absolutely perfect. That comes down to the choice of infrastructure, the fume cupboards and the air handling units and the design, in the delivery of air."**

### Temperature

Despite concerns that there may be issues with the internal room temperature in the winter months, because the Chemistry Building has an aged heating system, the problems have not been significant. There have been some fluctuations in temperature but the lab is now generally warmer in winter than it was previously and, due to the double glazing and the solar film on the windows, it does not get too hot in the summer.

### Lighting

Whilst the increase in natural light into the space has been successful, there have been issues with the artificial lighting.

The artificial lighting grid is not balanced across the space giving shadows on benches. This is a result of a change in the location of the boom during construction, which impacted on the lighting grid. Whilst the lighting meets specification, there is such a variation across the laboratory that it is causing occupational health issues.

Other issues were highlighted around lighting

- There is currently no override switch on the motion sensitive lighting
- Wall switches are not labelled to indicate which lights they correspond to in the store room, the light is on a timer, which times-out if too long is spent in the room. It can be difficult turning the light back on if you are holding trays of equipment.

**"They designed the lighting grid before they put in the service booms. This means that the room is effectively split into three and means the lights in the centre zone are off set rather than going across and aesthetically it looks appalling but functionally it does meet specification."**

### Recommendations

- During the design phase, understand, by talking to the end users, what is required in terms of light levels in each area of the lab
- Tease out, during the design period, any special considerations that may impact the lighting design, such as whether there are any light-sensitive operations so that the design can take account of these

- Ensure there is coordination of the design prior to tender and the construction phase
- Commission an analysis of the lighting levels in S-Lab and interrogate records of lux levels.
- Review the efficacy of the current S-Lab lighting controls.
- Consider adding labels to the switches on the walls, to indicate which lights they correspond to.
- Keep things simple by using traditional light switches with on/off switches.
- Add a switch to override the motion-sensitive light switches.
- Check operation of existing lighting timer device in the store room.
- If the store room light is not mal-functioning, re-commission existing device
- Determine whether or not the racking in the store room is shielding the motion detector.

### Noise levels

None of the respondents reported any issues concerning noise levels.

### Data connectivity

Satisfaction with data connectivity, amongst the internal clients and users, is high. The data connectivity was over-specified and several respondents commented that the WiFi generally works well, although there is some scope for improvement.

The iPad keeps losing connectivity. It was felt that it would be beneficial for S-Lab to have its own wireless network.

#### Recommendation

- Investigate the possibility of giving S-Lab its own wireless network in order to improve connectivity.

### AV equipment

The end users are highly satisfied with the AV equipment, attributing its success to a clear brief to the designer regarding the school's requirements. Since the completion of S-Lab, the University of Nottingham has taken AV to another level, by involving a key member, of the University's I.S. department in 'blue-sky' thinking to develop and test the AV possibilities for future lab developments.

However, there were areas where improvements were suggested:

- University personnel would have benefitted from more training and more time to evolve and adapt to new methodologies
- There is a need to simplify the process enabling students to access measurements directly from their tablets. Currently the measurements are located on the PC and accessing them causes 'bottlenecks' in the lab
- The flexible screens are not considered to be large enough to be seen by 100 students and workshop participants raised the question as to whether the information displayed on the screen could be streamed to the tablets. There is no volume control for the audio system in the middle section of the lab.
- There has been no software update received since the lab was first occupied.

### Recommendations

- Make sure that the relevant I.S. partner for the project is involved at the earliest opportunity, especially where the project has special requirements.
- Look at the process for transferring data from the spectrometers consider how this could be improved.
- Consider whether the information displayed on the flexible screens could be streamed to the tablets.
- Add a volume control for the audio system, in the middle section of the lab.
- Discover whether a software update is needed and apply if necessary.

## FEEDBACK RELATING TO THE OPERATION OF THE LABORATORY

### Maintenance work on specialist equipment

Respondents highlighted that, after the twelve-month defects resolution period is over, PPM and repair work is being carried out without sufficient knowledge of the equipment or without taking into account which systems are in operation. It was also highlighted that, on occasions, settings on the equipment had been altered without permission of the relevant members of the lab team. The fume cabinet supplier has also voiced concerns about the maintenance team making changes to the specialist systems.

### Recommendations

- Strict processes should be implemented to ensure that maintenance is conducted correctly, for example, maintenance personnel must be briefed by the internal client before carrying out PPM or repair work on the specialist equipment.
- Ensure that settings are not altered on the specialist equipment
- The maintenance team must not report just to the Chemistry department office but must liaise directly with the internal client before any checks or operations are carried out on the specialist equipment and systems.
- If a piece of equipment fails a test, the department must be informed and ‘fail’ stickers must be placed in a position that makes them easily visible.

### Reporting faults via the helpdesk

Academic personnel, at the workshop, were keen to point out, that a day’s waiting time for the resolution of a fault, may have significant implications for teaching staff and students and so it is important that individuals reporting faults are made aware of the probable resolution timeline.

The helpdesk does not always differentiate between latent defects and maintenance issues.

### Recommendations

- Make it clear at handover, to all relevant parties, the procedure for reporting faults and what the response times are likely to be.

- Convey, to individuals reporting faults, the time it will take to resolve an issue, as issues can impact teaching.
- Ensure that staff on the helpdesk can differentiate between latent defects and maintenance issues.

### Technicians' fume cabinets

The technician's fume cabinets in S-Lab are slightly lower in specification than the other fume cabinets. This means that the technicians are unable to fully replicate some experiments when they are preparing for teaching. If these cabinets were at the same level of specification as the rest, they could act as a useful back-up if any fume cabinets in the lab fail. Students with special requirements, who cannot work in large group environment, could then work with supervision in this area.

#### Recommendation

- Explore the feasibility of upgrading the technicians' fume cabinets to the same level of specification as those in the lab.

## FEEDBACK RELATING TO OPERATIONAL AND QUALITY ISSUES

The pressure on the programme did lead to some compromises on quality of the finished product. Following occupation, there have been some quality issues reported by users:

**"There are elements of work that we would not accept, but we did because of time. Fan positions externally is a big one. Duct work material and duct work positions in the lab also. None of them are deal-breakers but there are just so many compromises that we made because there was not the time to hold them to account effectively."**

One overarching recommendation for those elements where quality was an issue, was to apply the knowledge drawn from the experience of S-Lab when consulting with suppliers on future projects.

### Durability of bench castors

One end user of S-Lab reported that the castors of the adaptable benching are not sufficiently durable, and liable to break if moved to frequently. They were not, however, aware that the benches should be cleared before they are moved, to reduce weight.

#### Recommendations

- Procure more durable castors for the adaptable benches.

### Quality of door handles and hinges

Two key issues were raised concerning the quality of door handles and hinges. Firstly, instances have been reported of users cutting their hands-on door handles, as they can be sharp, although this has been less of an issue of late. Secondly, end users did report that doors regularly fell off the white cupboards because of poor quality hinges.

#### Recommendation

- Call in the supplier to review the quality of the hinges and door handles and make replacements.
- Utilise this knowledge on future projects and speak to suppliers about upgraded fittings.

### Taps in the fume hoods

The taps in the fume hoods were reported to become loose over time as students pull tubing on and off regularly, which results in them needing to be tightened every few months. This means that there is a need to upgrade the taps to something more robust.

#### Recommendation

- Call in the fume hood supplier to review the quality of the taps and make replacements.

### Flooring

The floor suffers chemical damage easily, resulting in ugly discolouring.

#### Recommendation

- Review the specification of the flooring.

### Extraction

Strong chemical smells build up inside the cupboards, due to the lack of extraction

#### Recommendations

- Look at the possibility of installing extraction to reduce the build-up of chemical smells in the cupboards under the fume hoods.

### Hot water

There are under-bench water heaters in the centre of the lab, but the water loses heat if large quantities of glassware are being washed. However, the designers were clear that there were solid reasons why the supply was not connected to the domestic hot water system in the first place

#### Recommendations

- Investigate the viability of connecting to the building’s domestic hot water system

### Zone labelling on the fume hoods

The stickers on all the fume hoods stating which zone they are in, have been removed.

#### Recommendation

- Permanent labelling to be fitted to the fume hoods by the end users, to indicate which zone they are in.

### It is not clear which lights correspond to which vented cabinets

It is currently unclear which wall light switches correspond to which vented cabinets.

#### Recommendation

- Go back to the supplier to check which wall mounted switches correspond to which vented cabinets, and label the switches accordingly.

### Resolution of defects

Several respondents reported that it has taken more time than they would have liked to resolve the minor defects. For example, there are areas where silicone sealant has been pulled up. The end users have never received the collars to stop people accidentally activating the emergency stoop buttons and the electronic door release at the back of the lab has only worked for the first three months of occupation.

#### Recommendation

- On future projects, take steps to ensure that minor defects are resolved in a timely manner.

### Security

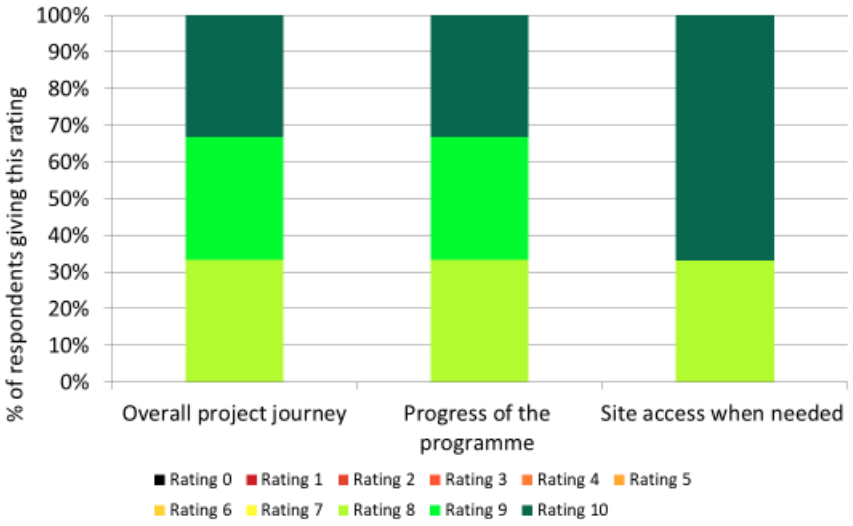
One respondent raised a concern regarding the security of S-Lab, noting that whilst the key to the main door of the lab is a GM16 key which only the lab staff have access to, the back door of the lab is accessible using a general A2 key, which a lot of people are issued with. A swipe card system would be more secure.

#### Recommendations

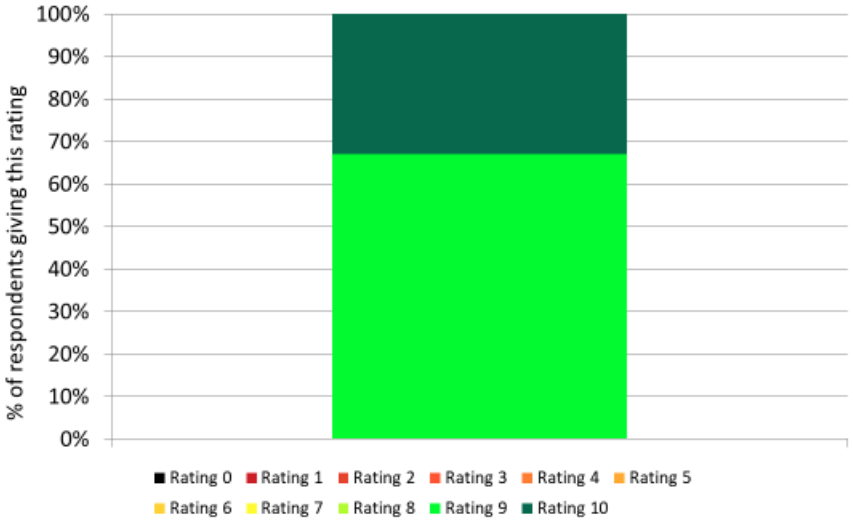
- Create a unique key for the rear door of the lab, for the short term
- Discuss possible solutions with the internal client
- Go back to the supplier for an improved solution.
- Consider upgrading the lock on the rear door of the lab to a card-access system for authorised users.

# APPENDIX I: QUANTITATIVE RESULTS

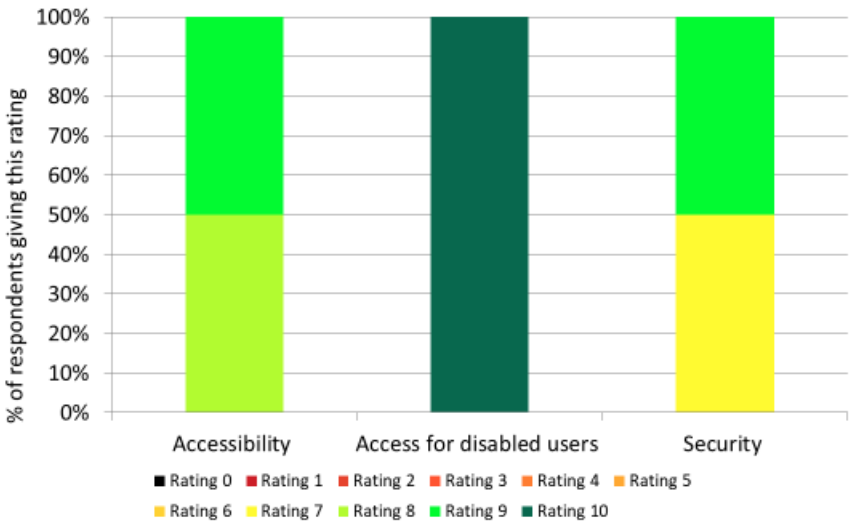
1.0 Satisfaction with elements of the project journey



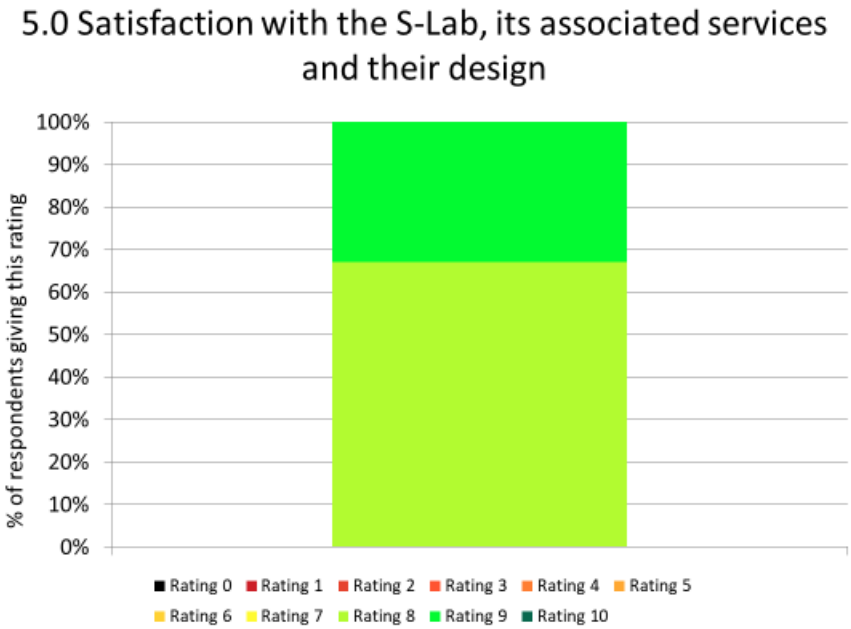

2.0 How closely the outcome of S-Lab met expectations



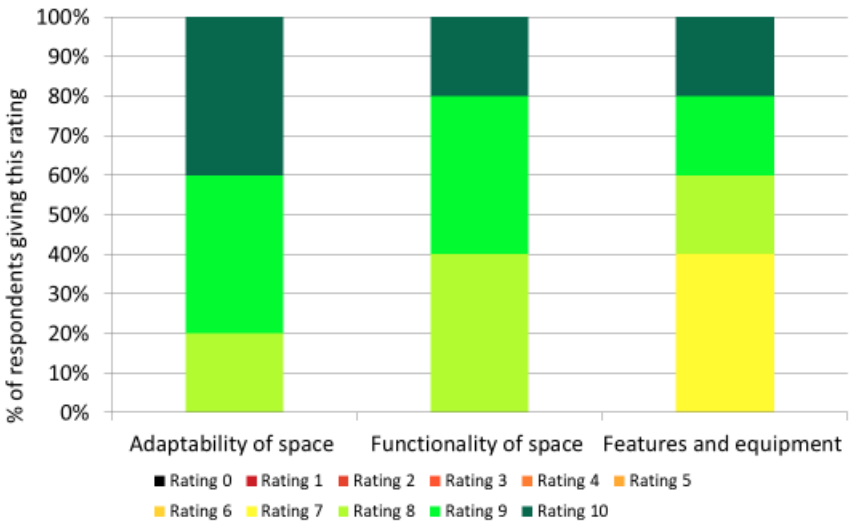
## 3.0 Satisfaction with S-Lab's accessibility




## 4.0 Satisfaction with the quality of S-Lab and the team involved in the programme

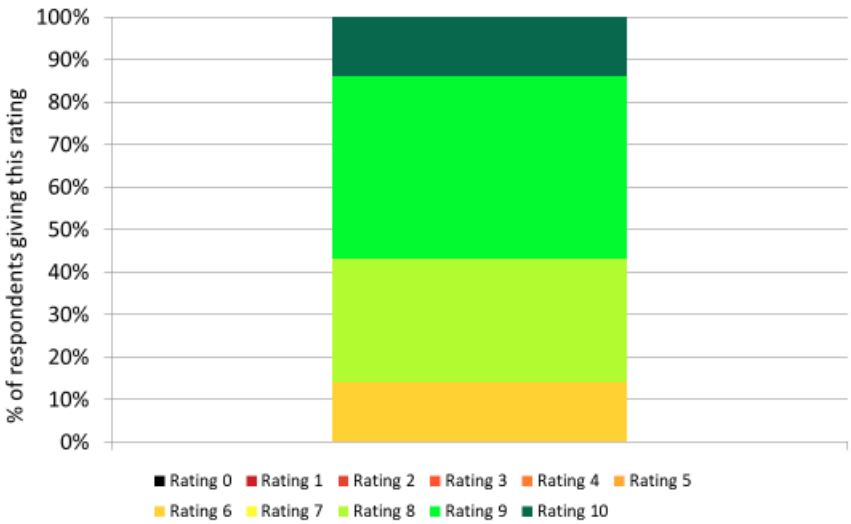

5.0 Satisfaction with the S-Lab, its associated services and their design
% of respondents giving this rating
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Rating 0
Rating 1
Rating 2
Rating 3
Rating 4
Rating 5
Rating 6
Rating 7
Rating 8
Rating 9
Rating 10

## 6.0 Satisfaction with S-Lab's layout and space




## 7.0 Satisfaction with S-Lab's internal environment

## 8.0 Satisfaction with the overall outcome of the project



# APPENDIX III: SUMMARY OF RECOMMENDATIONS

## THE DESIGN AND CONSTRUCTION PHASE

### Building Survey information

- Discover whether members of the department occupying the building have, on file, any information regarding the building.
- Keep the records from previous modifications and newer buildings up to date and make them easily accessible for future projects.

### Lack of information regarding specific I.T. equipment

- Ensure that all information required for the installation of devices is provided to the I.S department at the correct juncture.

### The programme was not sufficiently detailed

- Build more lead-in time into the project, to enable the contractor to plan the project sufficiently, circulate the drawings and to allow for the time it takes to obtain equipment that is manufactured abroad.

### More time needed for sign off on the specialist services

- Ensure that sufficient time is 'ring-fenced' to give end users the opportunity to finally sign-off the specification.
- Tease out the brief in discussion with the internal clients, to understand specific and exact requirements.
- Draft a specification and ask all parties to review it.
- Talk to multiple suppliers and ensure that there is clear understanding of whether they can meet the specification in full.
- Once the contractor is on board ensure they understand the specification and explain what is required to the party that will be installing the system

### The testing of equipment

- Allow sufficient time to ensure that thorough testing of all equipment is complete.

### Coordination of Mechanical & Electrical services

- The role of dedicated M&E coordinator will be written into future tenders on complex jobs. The CV of the individual proposed for the role should be provided, as evidence that this individual exists and has the required experience, and they should be available for interview during the tender process.

### Handover

- Make a member of the maintenance team available on the first day of operation, to check basic things, such as the tightening of the taps.
- Talk to the University media office about taking care not to admit press and photographers to the lab on the first day of operation.
- Ensure that the O&M manuals are delivered, in full, on time.

### The location of the chemical traps

- With immediate effect, place a COSHH label on the door of the plant room to direct people to take the required safety precautions or contact a specified individual for assistance.
- Check with the supplier why there is no warning light showing on the control panel, to signal that the traps are full.
- Ensure the catch pots are checked every day because of the potentially hazardous mixtures.
- A robust local procedure for maintenance (PTW) permit to works should be put in place.
- Investigate the possibility of relocating the pumps and catch pots to the ante room.
- If the catch pots cannot be relocated, consider installing a camera pointed at the catch pots or a meter to monitor the contents.

### Suitability of spaces for teaching larger groups

- For future projects, look closely at space requirements where large groups need to be accommodated.
- Consider replacing the doors on the storage cupboards with sliding doors.
- Consider providing screening for the storage area close to the lab entrance.

### Sustainability

- Consider adding variable volume drivers to fume cupboards.
- Switch fume cupboards off totally overnight.
- Keep chemicals in ventilated cabinets overnight, rather than storing them in fume cupboards.
- Follow the example of the GlaxoSmithKline Carbon Neutral Laboratory for Sustainable Chemistry and use a consultant to assess the cost/benefit of adding sustainable features.

## POST-OCCUPATION ISSUES

### Lighting

- During the design phase, understand, by talking to the end users, what is required in terms of light levels in each area of the lab.
- Tease out, during the design period, any special considerations that may impact the lighting design, such as whether there are any light-sensitive operations so that the design can take account of these
- Ensure there is coordination of the design prior to tender and the construction phase.

- Commission an analysis of the lighting levels in S-Lab and interrogate records of lux levels.
- Review the efficacy of the current S-Lab lighting controls.
- Add labels to the switches on the walls, to indicate which lights they correspond to.
- Keep things simple by using traditional light switches with on/off switches.
- Add a switch to override the motion-sensitive light switches.
- Check operation of existing lighting timer device in the store room.
- If the store room light is not mal-functioning, re-commission existing device
- Determine whether or not the racking in the store room is shielding the motion detector.

### Data connectivity

- Investigate the possibility of giving S-Lab its own wireless network in order to improve connectivity.

### AV equipment

- Make sure that the relevant I.S. partner for the project is involved at the earliest opportunity, especially where the project has special requirements.
- Look at the process for transferring data from the spectrometers and consider how this could be improved.
- Consider whether the information displayed on the flexible screens could be streamed to the tablets.
- Add a volume control for the audio system, in the middle section of the lab.
- Discover whether a software update is needed and apply if necessary.

### Maintenance work on specialist equipment

- Strict processes should be implemented to ensure that maintenance is conducted correctly, for example, maintenance personnel must be briefed by the internal client before carrying out PPM or repair work on the specialist equipment.
- Ensure that settings are not altered on the specialist equipment
- The maintenance team must not report just to the Chemistry department office but must liaise directly with the internal client before any checks or operations are carried out on the specialist equipment and systems.
- If a piece of equipment fails a test, Joanne Green must be informed and ‘fail’ stickers must be placed in a position that makes them easily visible.

### Reporting faults via the helpdesk

- Make it clear at handover, to all relevant parties, the procedure is for reporting faults and what the response times are likely to be.
- Convey, to individuals reporting faults, the time it will take to resolve an issue as issues can impact teaching.
- Ensure that staff on the helpdesk can differentiate between latent defects and maintenance issues.

### Technicians' fume cabinets

- Explore the feasibility of upgrading the technicians' fume cabinets to the same level of specification as those in the lab.

### Operational and quality issues

- Procure more durable castors for the adaptable benches.
- Call in the supplier to review the quality of the hinges and door handles and make replacements. Utilise this knowledge on future projects and speak to suppliers about upgraded fittings.
- Call in the fume hood supplier to review the quality of the taps and make replacements.
- Review the specification of the flooring.
- Look at the possibility of installing extraction to reduce the build-up of chemical smells in the cupboards under the fume hoods.
- Investigate the viability of connecting to the buildings' domestic hot water system.
- Permanent labelling to be fitted to the fume hoods by the end users, to indicate which zone they are in.
- Go back to the supplier to check, which switches correspond to which vented cabinets, and label the switches accordingly.

### Resolution of defects

- On future projects, take steps to ensure that minor defects are resolved in a timely manner.

### Security

- Create a unique key for the rear door of the lab, for the short term
- Discuss possible solutions with the internal client
- Go back to the supplier for an improved solution.
- Consider upgrading the lock on the rear door of the lab to a card-access system for authorised users.