SETTING UP OR RENOVATING A LABORATORY

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Receiving money to set up or renovate a lab is a wonderful experience! Many researchers have a euphoric moment, imagining the possibilities for a new, slick, streamlined workflow that will result in hundreds of papers! That is ... until reality sets in and it becomes apparent that a lot of work is involved. Setting up a lab does not need to be stressful though (e.g. Wiedenbeck 2013); it just involves a lot of planning, communication and adjustments to timetables and scope – similar to renovating a home. Laboratories in the Earth sciences today cover a wide spectrum, from specialised facilities for instrumentation (Fig. 1) to clean labs for organic or trace element geochemistry (Fig. 2) and to rock-crushing and computer labs. Books could be written on the experience of lab renovations, and every researcher will have distinctive needs. In this article, we provide a 'checklist' of sorts for the process of setting up the types of laboratories used by most *Elements* readers.

Figure 1 The sensitive high-resolution ion microprobe (SHRIMP) lab at the Australian National University houses three different ion microprobes, with plenty of surrounding space for modifications and installation. Prof. Trevor Ireland for scale.

For graduate students and postdocs: our advice is to start thinking about your own lab now. Figure out what works well in the beautiful lab that you currently work in and what you think could be improved given the opportunity? Why is the layout the way it is? When maintenance or repairs are needed in the lab, pay attention to what is going on and talk to your supervisor or the lab manager about operational details (most of us really like talking about our labs and their special design). If there are particular types of equipment that you like or dislike, make a note of them.

FIRST THINGS FIRST: COMMUNICATION

Setting up a lab is a time when communication skills are at a premium. This is the time to talk to former supervisors and colleagues who have installed similar laboratories. Or better still, visit them – to get their tips on processes and supplies. Knowing what doesn't work or where they have had problems is as important as knowing what does work. If you plan to use specialized instruments, the instrument salesperson may have important tips on the renovation and installation process, as well as room specifications for the particular instrument that will need to be met before installation. Expect to be in contact with building contractors like plumbers, electricians and carpenters, and for a new lab or major refurbishment even architects. Your building manager (or equivalent) will likely supply a lot of advice and may help with budgets and contacts. Finally, you will need to coordinate carefully with occupational safety advisors in your workplace to ensure that the lab design meets the current safety requirements of your institution. The requirements may include safety showers and eye-wash stations and possibly wheelchair accessibility. This is something that needs to be done early in the planning process and included in the budget to avoid unpleasant surprises.

PLANNING A LAB THAT WORKS FOR YOU

You might wish to first start with a list of the processes to be used in your lab to ensure that you have a good workflow in the room. For instance, if you need to access the sink for several different tasks, then a central position (for example, at the end of a peninsular bench) may work well. For clean labs you might design the workflow from the entrance to sequentially cleaner areas in the interior, perhaps with rooms within rooms. For instrument labs it is important to design easy accessibility for when instrument servicing is required. By clarifying how you will use the room, hopefully you can better communicate to your senior colleagues the need behind your requests – this process often results in changes to your floor plan!

BUDGETS AND TIMELINES

In almost all cases, despite how generous your start-up package, the budget probably will not allow you to have everything on your wish list. Prioritise the requirements of the lab necessary to achieve the best possible results, and distinguish functionality from the cosmetic. Yes, you might really need the highest-performance, most expensive fume hoods, but do you really need the most expensive furniture? The quality of data produced does not correlate with the total cost of the lab. Plan for the future – you want your lab to be functional and attractive now and several years from now. For example, in a chemistry lab the floors and bench tops may be rated acid resistant, but do dilute-acid spills cause stains? Typically, you will be given a choice of materials for floors and bench tops – try out some samples. Think also about what standard maintenance will be required, in terms of both budgets and lab access. Is it easy to access fume hood scrubbers or air filters for routine service or will the lab have to be shut down, and what will be the replacement costs? Consider energy efficiency in the design of the lab. For example, if you need cooling water find out if there is a building recirculating system that you can tap into or if you should install one in the lab rather than putting water down the drain.

Figure 2 Magda Huyskens checks a still in the isotope geochemistry clean lab at the Australian National University. Clean labs require particular attention to detail during renovations.

During the planning process, the project coordinator at your institution will work with you to put together a timeline for completion of the lab. A usual first reaction is, "Will it really

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take that long? I need to get data now!" Yes, it will take a long time and probably longer than forecast. Here is where you need to develop a good working relationship with the project coordinator: try to make him understand your particular requirements and listen as he explains his constraints. This is best done by regular, calm meetings. Particularly when renovating in older buildings, there will be surprises. The building plans may not be up to date, or there are problems with ducting, wiring or asbestos that will need to be addressed. This is where you and your construction team will need to be creative and flexible. It is extremely important to be clear in your own mind about the requirements for the lab. Some things you can compromise on and some things you cannot – for the latter you will need to provide reasonable justifications. Your lab will be unique, and although you are working with professional contractors they will likely not have come across your set of special requirements before. It may be puzzling to them why certain, more difficult materials have to be used or why a layout has to be a certain way. Be patient and stay on top of, but not in the way of, construction progress. Ask for regular walk-throughs and updates to catch mistakes (yours and theirs) as soon as possible. It is a long process, but the lab will get finished and it will all have been worth it.

FIGURE 3 These three drawers have different styles of inserts that provide storage for a range of items.

REFERENCE

Wiedenbeck M (2013) A new facility for the Geoforschungszentrum. Elements 9: 328-329

LAB CHECKLIST

Room requirements

- What size is required? How many people need to work in the lab? How many different processes will go on at once? How much and what type of storage (for tools, chemicals, etc.) is required? (FIG. 1)
- Will you need separate rooms or spaces for different processes or tasks?
- Are there any special requirements regarding vibrations, magnetism, temperature control, sunlight, drafts, dust-filtering, humidity control or sound damping?
- Can equipment be delivered to the lab easily (for example, through doors, corridors and elevators)?
- Are there benefits to having the lab close to other facilities, teaching classrooms, etc.?
- Will the room need particular paint, flooring or window coverings (FIG. 1)?
- Will the room need a pass-through airlock chamber for environmental control, or is a change area needed for coats, bags and outside shoes?
- Does the room require particular security (for example, motion sensors, locks, safes, doors with tempered-glass windows, phones)?

Services

Are particular services needed, such as:

- a vacuum line
- exhausting fume hoods or clean-air boxes (or access to one)
- venting or delivery of gases / dry air
- a high-pressure, dry-air line
- chilled water
- tap or deionized water systems
- specific power requirements, including backup power
- safety shower, eye-wash station, fire extinguisher
- sinks with special traps
- wireless/Internet/phone connections

Cabinetry and furniture

- Should benches be of standing or sitting height? Will there be knee space or cupboards/drawers underneath? Will benches form a peninsula and/or rim the room? Will these need special surfaces (metal-free, acid- or scratch-resistant)?
- Are cupboards required above the benches? Do cupboards need glass fronts? Do drawers need to be made from special material or have storage inserts? (FIG. 3)
- Do you need a sink and draining rack or a dishwasher?
- Are chairs and/or stools required?
- Are tools best stored in cabinets or in specialized storage boxes or hanging systems?
- Is a flammable-solvents cabinet or chemical-storage cabinet required?
- Is easy access provided for safety equipment, like lab coats, gloves and safety glasses?
- Should gas-bottle harnesses be installed?
- Is the lab in a seismically active area requiring special shelving units?
- Is a specific area for heavy-tool work required?

Other items

- It is always easier to maintain equipment if the appropriate parts are nearby. Don't forget to plan some space for these items.
- A filing cabinet or bookshelf is not a luxury in labs where log books, instruction manuals, chemical safety sheets and reference books need to be stored.
- Space for a computer, data-backup hardware or a server, and a printer may be needed.
- Is there space for expansion?