HOW TO BE A GOOD UNIVERSITY RESEARCH TECHNICIAN?

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I am a senior research technician in engineering materials science at the University of Queensland (UQ). Currently I work for the CRC Cast at UQ Brisbane. I have 12 years work experience at the University of Queensland, and have spent nearly 30 years in a number of research fields, with different projects, under diverse work conditions with different chief investigators in several other universities and institutes. I have often achieved results that were judged to be outstanding. I would like to take this opportunity to share my experiences with this.

Most people would agree that the position of research technician in a university is of utmost importance to both scientists and general staff. A research technician has to deal with the high requirements of quality and reliability expected from university research. As we know, significant amounts of the experimental data or evidence are the results of the job done by the technicians. Thus, special attributes of knowledge, professional laboratory skills, problem solving capability and a strict and open attitude are necessary characteristics of a good research technician.

1. As a research technician, our purpose is to provide quality technical support to the research field. To achieve this purpose, first of all, it is important to fully and correctly understand the aim and requirements of the project task from the supervisor. If you also understand the background and other information relevant to the project, it would be even better.

   There is one experience that I have always remembered. A few years ago, a materials scientist joined our department and became one of my supervisors. He was not based at UQ but his office was in another institute. One day, he sent a small specimen with a very short note: "*Please find and check all the phases in this specimen and identify the composition."* From this short note, it seemed like a very normal job in our materials field. Usually you can complete it by taking only three steps. 1, to prepare a metallography sample; 2, to use a microscope to observe all the phases; and 3, to use a spectrometer spark machine to analyse the average composition. I am a metallographer, so this task for me was everyday bread and butter. I started to work following the steps together with a number of other jobs. Two days later, this supervisor rang me and asked, "Have you started to do this work?" I said yes then he said "Oh good! I knew this is a hard job, thank you very much. I'll invite you to have a coffee when you finish it." Wait a minute! I think there is something wrong! The way he spoke it didn't sound like a standard job! I became dizzy! Then I very gently asked him: "you told me to check all the phases… " "By using the micro**probe**…" he continued and completed my sentences, I continued to ask: "and determine the composition…" "…different between each phase." "But you didn't state clearly the full requirements in your short note?" "Oh! I'm sorry. I thought you would know it. At my home University, when we say: "check the phases and get the composition," that usually means use the micro**probe** to do it. Micro**probe** **(picture)** the full name is **Quantitative electron probe microanalysis.** This is a highly specialised technique and equipment, which is based on either energy-dispersive X-ray spectroscopy (EDS) or wavelength dispersive X-ray spectroscopy (WDS); to generate composition data that are commonly used to identify different phase constituents. To use it you must have an operator licence at UQ. I had the licence but not for Australia. What is more, in order to obtain a qualified licence, you need to attend at least a 1-month training course! But I had no choice. I had to start from the beginning. After 3 and half weeks I passed the course and received the licence. Another 2 weeks later, I had a coffee with that supervisor. Of course, there wasn't an accident and it didn't cause any serious mistakes. By this example, I just want to say: if you do not fully and correctly understand the requirements of the task, it can bring about such a different result, which could cause significant problems.

2. Secondly, to be a good research technician, it is necessary to have wide knowledge through comprehensive study and training. We need to understand the fundamental theories and physical principles in our research field. During the research processing, we should not only simply repeat the same operations but also become deeply involved in the project, try to analyse the results and rethink new principles. That is the route I always attempt to go. Over many years of work in material science research, I have contributed many useful suggestions and developed some new ideals for research projects. I have confidence that my skill abilities and content of my knowledge have advanced to a multifunctional level and I am able to carry out independently parts of the researcher's duty. Here are two examples that can illustrate my capability of developing effective problem solutions.

   First example. Grain size refinement is a very significant goal in Magnesium alloy research. However, once resulting a very successful experiment, the grain size became too small and too difficult to use in the ASTM average grain size-determining standard. I have developed a new magnesium alloys grain size measurement technique base on the ASTM E112-96. This technique is quite precise, and makes it easier to count the boundaries, with allowing presentation of the results in colour photographs. It has become a reliable procedure in the project of new Mg products development in our CAST laboratory.

   Here is another example: According to the request from an automobile company, we had to carry out a project aimed to determine the feasibility of shortening solution heat treatment times. This project took over three years and the goal was very successfully achieved. It significantly reduced the solution treatment time, saving in excess of $1 million of the manufacturing costs. During those three years, the project leader and other members had changed a few times, but I was the only member in the team from start to finish. Everyone respected my opinions. I had been involved in the design of the experiment at each stage. The ideas of how to place the thermocouples, how to put the specimens in order to simulate industrial conditions, to increase the quenching temperature and using a per-heating treatment, those all came from my suggestions. These suggestions were basically on the understanding of the fundamental theories and physical principles. The company's engineering manager said: "We are extremely happy with the way in which CAST have run the project, the thoroughness of the research, the team approach with the AWP personnel, as well as maintaining cost and timing objectives, reflect the professionalism of the CAST team."
   Through these examples, you can see my principle, that is: before I do anything, make sure that I know why to do and how to do it.

3. Thirdly, to be a good research technician, we must have substantial operational skills and practical capabilities. A technician should be able to use, operate and monitor as many types of equipment and instrument as possible, should be able to manage or carry out several jobs at the same time and be capable of analysing and solving problems independently. If necessary, we should be able to develop and deploy new techniques. In my case, I have made sure that I learnt how to operate every piece of

equipment and instrument in several laboratories in our faculty. Many pieces of equipment I operated require a special licence or training. Such as the **EPMA** (X-Ray electron Probe Microanalysis), which requires more than one month training and practice to obtain the licence. Similarly with the **TEM** (Transmission Electronic Microscope), **SEM** (Scanning Electronic Microscope) and their miscellaneous sample preparation processes. Some of them require a long period of adjustment to achieve a constant working condition, such as **DSC** (Differential Scanning Calorimeter), **BLR** (Bolt load retention testing unit) and **Spectrometer analysis system**. Most of them require accumulated extensive experience in the properly use the instruments in order to obtain a high quality result such as **metallographic skills** and **Quantitative Image Analysis**.
(picture)
Let us talk about metallographic sample preparation. It requires skills involving sectioning, mounting, polishing and cleaning the samples without introducing damage or unwanted features, such as scratches or dirty spots. Believe it or not, after the finely 0.04micros diamond suspension polishing, how to wash the surface to remove those remaining white spots became a big issue that a lot of students and staff are unable to do properly. Even after washing over and over again, those samples under the microscope still appear to have some milky colour spots that make you feel so frustrated. But I know how to solve this problem. When you persist and find a knack, you can easily do it in 1 minute. I think when you practice enough times the solution is just coming to you! This often requires more persistency than Inspiration. I take personal pride in the quality of my metallography.

It is like ironing my laundry. I know most people hate ironing, but I like it. When you iron a complicated garment, it is a challenging job for a perfectionist. No matter how complicated it is (like some fashion model's dresses), you always do it step by step. We always divide the single garment into several sections; each section should be properly to fit your iron. As an efficient ironing lady, the only difference with others is, I divided the garment in as few as possible sections and to minimise the time spent doing each section. If I can divide into 5 sections then I never divide into 6 sections; If I can finish one section in 50 seconds, I never spend 1 minute to finish it. An efficient research technician is the same as an efficient ironing lady: divide the task in sensible sections and finish each of them as quickly as possible. Once I had to load and look after 7 heat treatment furnaces at the same time, while doing another 12 specimens preparation and density measurements, all in a single day. Still, I managed to finish all of the jobs at a quarter to six, in time to go home and cook dinner for my son.

I am also able to repair a number of small mechanical facilities by myself. That is just because I carefully watched and memorized what the repairmen do when they came to service the facilities. This includes the cutting machine, polishing plates, mini microscope; colour printer and data log system etc. In most cases, these kinds of jobs are outside my responsibilities, I don't have to do them. So why do I still do them? Because this is my division, this is my centre, this is my faculty and this is my university, I am the member of that and I love my job. I think we should treat our lab as our own home. If we consider saving money and resources for our home, then we should consider saving money and resources for our lab. These are my hands, if I can use them to do everything for my house, why can I not use them to do the things for my lab if I can. My professional knowledge, technical skills and many years work experience have given me a wide capability in my occupational skills. We are running very reliable testing facilities to contribute to the results of research projects. That just is the mission of our research technicians. We made our professional mission by our efficient work and contribution.

4. Fourthly, to be a good research technician, it is very important to be very strict regarding your research attitude. This profile includes respecting the truth; recording and collecting data precisely and honestly; rectify the mistakes immediately and do not overstate our achievements. We have the responsibility to deliver results that have been obtained with all care and checked repeatedly. These aspects of the career's ethic should also become our personal character to make sure the results from us are reliable and accurate. There are two cases from my career life that all relate to a strict research attitude, but reflected with one positive and one negative experience.

   The positive one is the Bolt Load Retention testing calibration processes. **BLR** testing is a core creep property test for vehicle-type applications. It was set up in our UQ laboratory a few years back. When I took over this duty, I found that some parameters used in prior tests had drifted and the apparatus was no longer accurate enough. For instance, the thermocouple zero point; the temperature distribution zone in the furnace and the bolts loading origin point. A drift in any of them meant that the results could be inaccurate and therefore misleading. I decided to do a full recalibration of the bolt load data recording system and a rebuild of the whole testing system. No one actually asked me to do it but I thought it was my responsibility. The whole exercise took a long time because to do the full calibration you have to test every parameter that could affect the final result. I tested low loading and high loading; single washers and double washers; alloy bolts, stainless steel bolts and Aluminium bolts; single sample, double samples and no samples; I corrected the drift in the initial zero point and redetermined the temperature distribution profile along the furnace degree by degree. After the job was done, I had enough confidence in this facility to start conducting the measurements. If I need to, I can easily locate any affected parameter when the result is unusual. Now BLR has become a special feature testing at CAST-UQ.

   A negative one happened about two years ago. I managed to purchase a spectrometer spark analysis instrument from **Thermo Optek** Australia. The instrument needs Argon gas supply to keep the spark stand running and working. At the instructions of the user guide, there is a very small note: <The Argon supply must be **high purity** (at least 99.xxx%)>. The character in the bracket was so small as a result that I didn't read it carefully. When I ordered an Argon gas from the catalogue handbook, an item labelled exactly the same called **high purity Argon** also with a small bracket was easy to find and I just ticked it straightaway, again without reading it carefully. The price of a gas cylinder was about $ 60, which is quite cheap. When the Argon cylinder arrived, we installed the whole instrument with the company engineer assistance and turned on the gas bottle. A number of researchers and PHD students were standing around with the aspiration to try using this machine. However nothing happened and the sparking head didn't spark at all. I then checked every part and couldn't see anything wrong. At that time, the company engineer walked towards me and lightly reminded me: "have you checked your Argon gas bottle label according to the instruction guide?" Suddenly I knew what was the problem! I rapidly checked my Argon bottle label which is: **high purity** (**99.99%)** and checked the user guide which is **high purity** (at least 99.995%). Here it is: a 0.005% disparity. Then I checked the catalogue handbook again and found it: in the formal catalogue book, the label of **high purity** was only used for two decimal point places. Any gas of higher purity has more then two decimal places such as three or four decimal places and are all called **Ultra High Purity.** The price of the Ultra high purity is about 3 times the price of the high purity. The user guide from the supply company's writing is:

high purity but (at least 99.995%). That meant we have to use the **Ultra High Purity** gas. I ran downstairs to borrow an **Ultra High Purity** cylinder, and then the problem was solved immediately. Afterwards the machine was running normal and the sparker was working well. Now you can see this is a trap from the supply company. The equipment was not faulty. I was upset with the supply company but then I realized that the only person to blame is myself for so careless of reading the notes. Unfortunately, the engineer didn't remind me until the last minute. Only 0.005% disparity can cause a totally different result! Same as yes or no, black or white. Since then, I have put that 99.995% label on the right hand of my desk to remind myself careful, careful and be really careful.

5. To finish off, to be good research technicians, we must keep ourselves up to date with the latest research methods, tools and skills as much as possible: such as utilizing computer software and digital techniques to deal with research results, and avoiding a redundant attitude. One may consider that there are always three generations in the University. First is the age sixty group, second is the age forty group and the third is the age twenty group. But the one thing different is that over the last two decades the information technology science and digital techniques developed dramatically. We are now in a great new era of information. Therefore the first and second-generation find it easier to face up to change and redundancy than thirty years ago. To avoid being eliminated by selection, to catch up with the latest steps, we need to update and renew our knowledge and skills all the time. The only way to do this is by continuously studying and training. One wonderful opportunity to get updated is through this TechTrain conference. But even so, many technicians cannot attend the conference. Most of us are busy with the day-to-day affairs without the time to improve ourselves. It is important not to become used to it. I believe that it all depends on ourselves. In my case, I just sent the application letter with my abstract to our sector leader, Cast-UQ leader and School manager, and they all showed their support, for which I am grateful.

   In fact I have same problem of being too busy to update my knowledge. As compensation, I try to replenish my knowledge during my daily work. I catch some new information when I work with young students and postgraduates. I take up some theories and experiences when I work with senior researchers. When we find that photographic in the darkroom is too dated then we manage to replace it by digital images. Of course I have to know these new technique well first.
   When I have some spare time, I often use to collect the latest references relating to our research field. This year, the Cast set up another new project. I am also a member of it. When the new project leader arrived, he gave me a long reference list including about 80 items and asked me start collecting them when I have time. 10 minutes later, I handed more than 50% of it back to him. He was so pleasantly surprised about how I did it so quickly. I told him this is my normal assignment. I collect them piece-by-piece and I present them at any time when people need them.

   A University research technician is a general staff position. We are all normal people. But I believe normal people in general staff positions can still perform outstanding masterworks.

   Thank you for your time.

A good scientist should be capable of explaining scientific ideas to a person who is not a scientist.[15] X Research source So always consider your audience and try to demonstrate your enthusiasm for your field of study without being overly complicated or hard to understand. {"smallUrl":"https:\/\/www.wikihow.com\/images\/thumb\/a\/a7\/Be-a-Good-Scientist-Step-11.jpg\/v4-460px-Be-a-Good-Scientist-Step-11.jpg","bigUrl":"\/images\/thumb\/a\/a7\/.Â To be a good scientist, don't be afraid to experiment and approach problems from a new angle, which is how a lot of scientific discoveries are made! You should also be very detail-oriented since noticing small details can make a big difference in science.