

**OCCUPATIONAL HEALTH AND SAFETY FOR PART-TIME STUDENTS, TEACHING STAFF AND RESEARCH STAFF AT
WMG DEPARTMENT, UNIVERSITY OF WARWICK**

**BEZBEDNOST I ZDRAVLJE NA RADU VANREDNIH STUDENATA, NASTAVNOG OSOBLJA I NAUČNOG OSOBLJA
NA WMG DEPARTMANU UNIVERZITETA U WARWICKU**

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KRATAK SADRŽAJ

Rad predstavlja okvire i nekoliko studija slučajeva vezanih za bezbednost i zdravlje na radu u WMG Departmanu (Warwick Manufacturing Group) Univerziteta u Warwicku, koji ima preko 800 zaposlenih i više od 2000 studenata. Fokus je prvo na vanrednim studentima osnovnih Bachelor studija upisanim na programe dualnog obrazovanja (DO) inženjerskih usmerenja, za koje su bezbednost i zdravlje na radu na prvom mestu među potrebnim znanjima, veštinama i ponašanjima njihovih DO standarda (ST0023, ST0024, ST0025, ST0027). Ovo uključuje procedure za praktičan laboratorijski rad, kao i povezivanje njihove obuke u kompaniji sa bezbednošću i zdravljem kad su na Univerzitetu. Drugi deo daje nekoliko primera bezbednosti i zdravlja na radu u laboratorijama za najsavremenija istraživanja, razvoj i izradu prototipova, obično u bliskoj saradnji sa liderima u industriji.

Generalno, rad pokazuje kako se procesi upravljanja rizicima decentralizuju i delegiraju svim studentima i svim zaposlenima, kako na osnovu potrebe da znaju, tako i potrebe da urade. Ovaj pristup postavlja čvrste temelje za uspostavljanje i razvoj duboke svesti o bezbednosti i zdravlju već od prve godine studija i neguje kulturu zajedničke odgovornosti među svim zaposlenima, obezbeđenu čvrsto definisanim granicama i ulogama.

Ključne reči: Bezbednost i zdravlje na radu, Visoko obrazovanje, Praktične i istraživačke laboratorije.

ABSTRACT

The paper presents a framework and several case studies related to health and safety (H&S) in the WMG (Warwick Manufacturing Group) Department, which comprises over 800 staff and more than 2000 students. The focus is firstly on part-time Bachelor students enrolled on Degree Apprenticeship (DA) programmes (dual education) in Engineering, for whom health and safety is listed first among the required knowledge, skills and behaviours of their DA Standards (ST0023, ST0024, ST0025, ST0027). This includes the procedures for the practical laboratory work, as well as linking their in-company training with health and safety whilst at university. The second part provides a few examples of health and safety in laboratories where cutting-edge research, development and prototyping take place, usually in strong collaboration with industry leaders.

Overall, the paper shows how risk management processes are devolved and delegated to all students and all staff, on both a need-to-know and a need-to-do basis. This approach sets a strong foundation for establishing and developing deep health and safety awareness among students from Year 1 onwards and cultivates the culture of shared responsibility among all staff, supported by firmly defined boundaries and roles.

Key words: Health and Safety, Tertiary Education, Practical Labs, Research Labs.

INTRODUCTION

The British Health and Safety at Work Act 1974 [1] was a groundbreaking legislation - one of the first laws in the world to apply to all places of work. It defined forming of the Health and Safety Executive (HSE), the public body for encouragement, regulation and enforcement of workplace health, safety and welfare in 1975 [2]. The HSE amalgamates the work of many sector-specific agencies – for example, the Railway Inspectorate existed since 1840. HSE focuses regulation of health and safety in 31 industry sectors, including education. The primary

responsibility for managing risks lies with the dutyholders – persons and organisations that create the risk. Therefore, The University of Warwick as a whole and each of its Departments/Faculties have staff who are responsible for managing and controlling risks under health and safety law. The overall structure of this setup and a few details about delegated responsibilities are presented in the following Sections.

OVERALL MANAGEMENT APPROACH FOR HEALTH & SAFETY AT THE UNIVERSITY OF WARWICK

The main University-level forum for health and safety **governance** is the University Health and Safety Executive Committee (UHSEC), chaired by the Registrar. Next, the Health and Safety Services team [3] embeds the principles of ISO 45001 across all departments. Within the team, the Director of H&S provides strategic leadership, the alignment with policies and collaboration with other Universities, whereas the Senior H&S Advisor leads the operational day-to-day activities across the three Campuses. They are working closely with Departmental Advisers, responsible for guidance and advice on all H&S matters within their departments. They must be degree-educated and NEBOSH (National Examination Board in Occupational Safety and Health [4]) qualified. Some of the Departmental Advisers have additional roles across the University, such as Bio Safety Lead/ Chemical Safety Lead/ Radiation Safety Lead. In addition to the H&S tasks, the staff of H&S Services work very closely with both Fire Safety Officers and the Community Safety Officers, to ensure the wholesome safety and wellbeing of over 7000 students who live on/near the main Campus, over 8000 staff and over 2000 staff of other companies that work in The Warwick Science Park.

The underlying **principle** comes from human rights: “all workers have a right to work in places where risks to their health and safety are properly controlled...” [5] and also informs the employees what is required of them:

- Take reasonable care of your own and other people’s health and safety.
- Follow any health and safety training you have received.
- Co-operate with your employer on health and safety.
- Tell your manager, supervisor or health and safety representative if you think that work or inadequate precautions are putting anyone’s health and safety at serious risk.

This immediately sets down the shared employer-employee responsibility for own wellbeing and the wellbeing of everyone else. Between every employee and the governing structures, **responsibilities** are delegated to:

- a) Heads of Faculties, Heads of Departments, Heads or Research Technology Platforms – who are following their tailored lists of “Plan-Do-Check-Review” activities.
- b) Technical Managers and Academic staff (Principal Investigators, Staff with Teaching Responsibilities, Space Owners) – who are expected to assess and address the risks associated with all research and teaching activities in line with university health and safety policies and requirements. This, amongst else, includes that all equipment to be used by their staff or students is checked for hazards, and that users/teachers are trained on safe systems of work and risk control measures prior to its first use, and any subsequent usage.

The **training** on H&S is mostly provided via online Moodle courses. Mandatory e-learning modules for all staff (including postgraduate research students), at induction and every three years thereafter, are:

1. Health and Safety Induction,
2. Display Screen Equipment (for those who work on computers),
3. Fire Safety Training.

Additional modules, strongly recommended for identified supervisors/managers are:

4. Risk Assessment Training,
5. Accident Investigation Training (including SHE/Evotix training).

For the purposes of safe work in laboratories, every employee (researchers, teachers and technicians) must undertake training on specific laboratory rigs they will be setting up, using and/or supervising its usage. More details are provided in the next two Sections.

HEALTH AND SAFETY WITHIN DEGREE APPRENTICESHIP PROGRAMMES

In 2013 dual education programmes on Bachelor (Level 6) programmes started under the name Degree Apprenticeships (DA). In addition to academic programmes specified by the IET [6] (or another professional body that accredits the degrees), these students must also demonstrate that they meet a set of knowledge, skills and behaviours (KSBs) of their particular DA Standard. WMG department of University of Warwick runs the Applied Professional Engineering Programme with four streams: Control, Electrical, Manufacturing and Product Design and Development, aligned with DA Standards ST0023, ST0024, ST0025, ST0027 [7-10].

It is interesting to note that health and safety is listed first in the required knowledge, skills and behaviours of all engineering DA Standards.

In most cases, these part-time students are actually interviewed by a company, for a job opening linked with a particular DA Standard and with the place on the DA programme. The successful candidates typically start their job in September and in the first week have training in H&S, both a generic-type training and training tailored to their job role. In October, when attending University, they have two lectures that reinforce the importance of H&S at work and illustrate the overarching role of the HSE. The first university coursework is issued and half of it is about H&S at their company and at their workplace. This assignment further emphasises the safety culture and also prompts them to start constructing their portfolio of evidence towards the KSBs. By the time the coursework is completed and marked (with a textual individual feedback), the students have built their knowledge in other subjects and will be starting the practical labs in engineering science – mechanics and electronics. The laboratory briefings, issued weeks in advance, include sections on hazards in the lab, potential hazards while conducting the practical work and measures implemented to reduce the risk to acceptable levels. The early coursework in one module, learnings of which are used in subsequent modules, demonstrates the need to approach learning in a comprehensive interlinked manner, rather than “teaching in silos” as they have often experienced in their previous education stages.

Because the DA students are working most of the time and do come to Campus in 3-day or 5-day intensive blocks, the lab briefings are issued via a learning platform (Moodle or MS Teams) and contain Word documents, PowerPoint slides, and pre-recorded videos. All these media contain a section on H&S in that particular lab; listing the potential hazards, the measures to reduce the risk as well as the “DO” and “DON’T” behaviours.

The relevant academic staff (the Module Lead and the Lab Space Owner) complete the Risk Assessment for the laboratory experiment well in advance and liaise every year to update it if necessary. They also train up any inexperienced staff that are supporting the laboratories for many groups.

The first example given in this paper is the laboratory work in electronics will have students assembling various circuits on a breadboard of the NI ELVIS platform (Figure 1) and powering them to capture signal waveforms on the oscilloscope. The open area of this platform is running at 5 V or 15 V, so it is perfectly safe if a careless student accidentally touches it. On the other hand, all equipment powered by 230 V is safety-tested once a year under the Portable Appliance Testing (PAT) regulations, including any extension leads, the chargers for the ELVIS platform and the chargers for university-owned laptops for collecting the results of experiments.

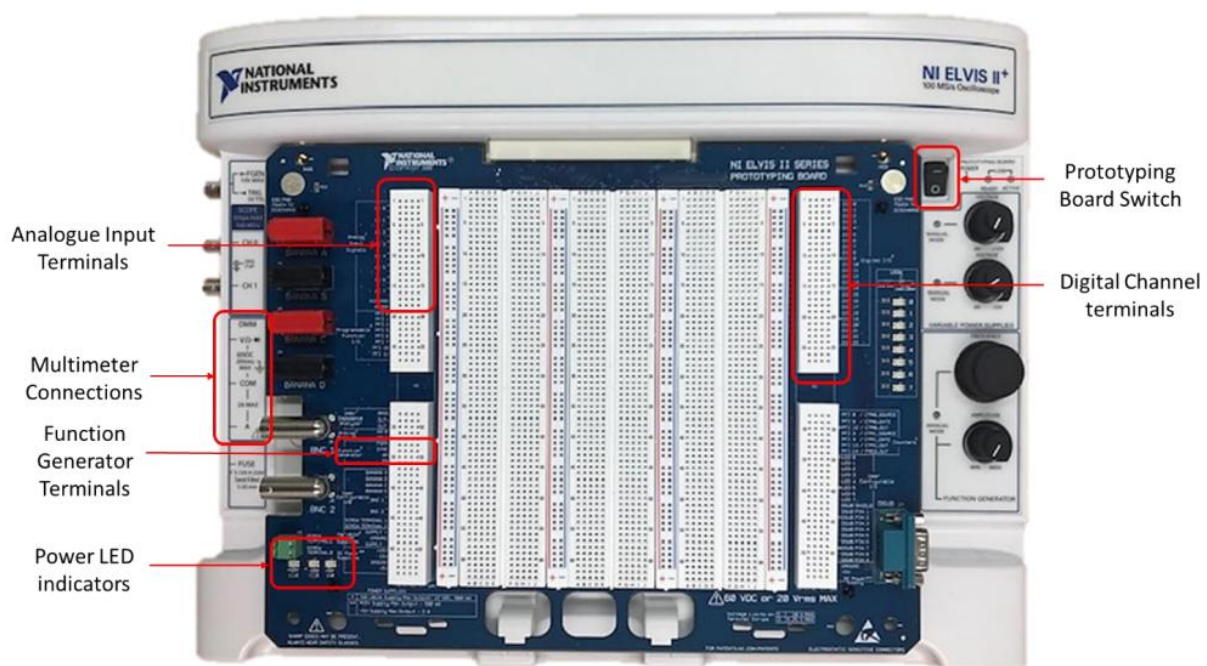


Figure 1: NI ELVIS Platform, with guidance on some connectors and functions [11]

The second example is the lab in solid mechanics on stresses in two-dimensional trusses, Figure 2. The lab objective is to experimentally record the magnitude and direction of forces in a complex truss structure and to compare the results with theoretical calculations. **Error! Reference source not found.** details the risk assessment for the equipment, as given in the written brief. Students are required to familiarize themselves with the hazards, precautions and safe behaviours required for minimising the risk and thus ensuring their own safety and the safety of others.

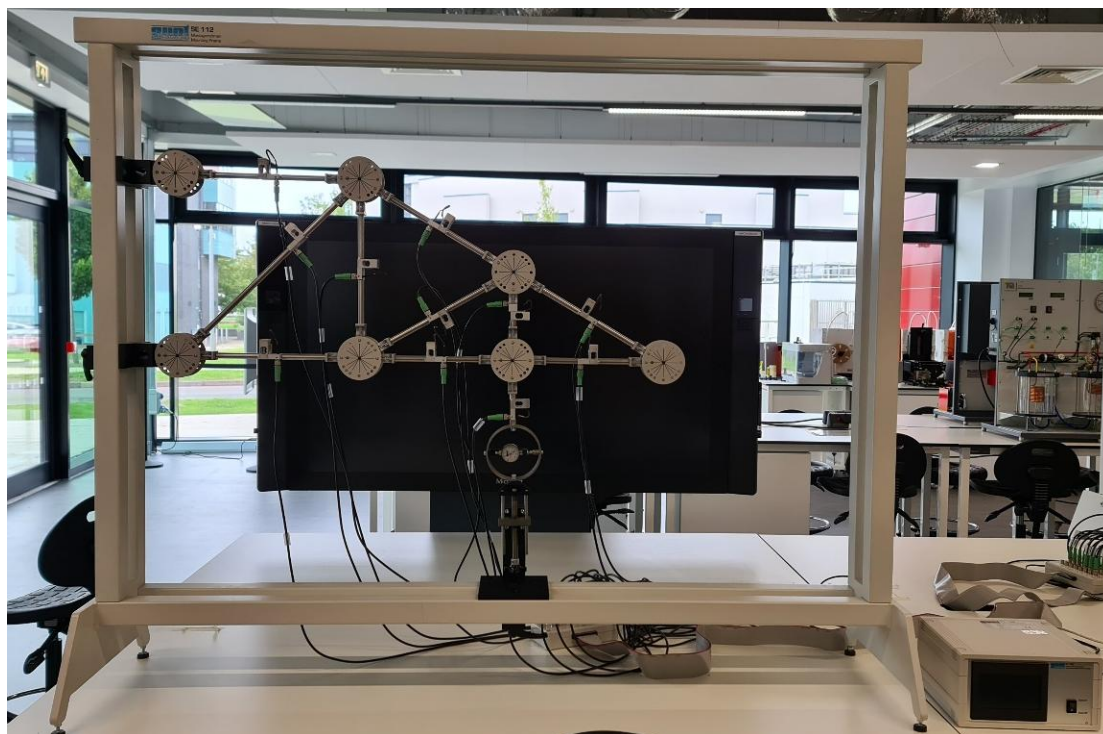


Figure 2: Experimental setup of a truss lab, with GUNT GSE110.21. test rig

Table 1: Risk assessment for the truss lab [12]

Hazard Type	Risk Level	Precautions
Injury from toppling equipment	Low	Ensure equipment is on a flat, stable surface and that the equipment is not subjected to any lateral forces. Do not lean on it.
Injury from lifting or carrying equipment	Low	There is no reason for students to lift or carry the equipment. Only do so under supervision of a member of technical or academic staff.
Injury from breaking the equipment	Low	Do not overload the truss. The maximum permissible force in each member is ± 400 N
Electrical shock	Low	Before turning on the electrical power, visually check all wiring for damage and ensure that all main leads are properly connected and are not loose within their sockets. Any problems should be reported to academic or technical staff.
Food and drink contamination	Low	Food and drink are not to be consumed within laboratories. You should wash your hands before and after the laboratory.

This approach has ensured that the students are well prepared for safe experimentation work. No incidents have been recorded in the last 6 years, with over 90 groups (500+ students) completing the lab.

HEALTH AND SAFETY IN BATTERY RESEARCH LABS

The WMG Department is renowned for strong collaboration with industrial partners for developing new products, new manufacturing processes and new technologies. Within the Energy Innovation Centre, a cutting-edge research has been done by the Battery Systems Group [13], who work on improving overall performance of modern batteries, and by the Battery Materials and Cells Group [14], who offer a complete development

pipeline from materials research to scale-up production. These two research groups have significant experience in designing, certifying, and putting HV batteries into service, now going beyond lithium-ion chemistry.

In addition to research and development activities, their staff are founders of two “Battery Schools”. The WMG Battery School is a short course for engineers and technologists in industry, whereas the WMG Faraday Battery School, designed in partnership with the Faraday Institute, is aimed at young researchers of the future. Both have a significant amount of hands-on experiences, which entail work with aggressive chemical elements and compounds. Many course attendees have not come across such chemicals, and they need to be fully aware of the safe execution of practical tasks like:

- mixing of an anode slurry and its characterisation,
- coating and drying of an anode slurry,
- battery cell assembly and formation,
- battery cell disassembly for forensic investigation, etc

Therefore, special risk assessment procedures and forms have been developed for each practical activity of the Battery School courses. Parts of risk assessment form for mixing and coating of anode slurry is shown below.

Table 2 present a part of the risk assessment header page, with entries that in a simple manner explain what is being done, who is doing what and the location of activities. This is followed by clear definition of training completed and the links to 5 other risk assessments (one for Lab and 4 for specific equipment) and a link to the COSHH listing for this practical activity (a separate document).

Table 2: Risk assessment form for mixing and coating – parts of headings.

Risk Assessment Title	Risk Assessment for EIC Faraday Battery School Practical 1: Mixing and Coating / 01-006-L01-010A
Description of Space or Activity/Task or Equipment	Mixing of an aqueous-based anode slurry in 1L Eirich mixer operated by a demonstrator, students will carry out slurry QC characterisation (solid content, Hegman and Rheology) and drawdown coating onto copper foil and drying on a hot plate. Students will see calendering processing by demonstrator. All activities will take place in the wet chemical laboratory as part of battery school
Additional Information	Demonstrators are trained and competent in the use of Eirich 1L mixer, drawdown coater and slurry characterisation techniques. Member of EIC staff supervising will always be present. LINKS: RA-407 Space RA Wet Lab RA-997 1L Eirich RA-415 Erichsen coater RA-1480 Rheometer RA-913 Calender COSHH Battery School Practical 1: Mixing and Coating

The Risk assessment form then lists 12 possible hazards, which range from handling compressed nitrogen via electric shocks and exposure to chemical to slips/trips while moving in the lab. Each entry clearly states all the usual risk assessment aspects: hazard type; who may be at risk; existing measures; likelihood; severity; overall risk; additional measures and the new risk level. Then the risk assessment gives a conclusion, Table 3, which again emphasises the responsibilities of students as well as the staff.

Table 3: Conclusion of the risk assessment form for mixing and coating.

Assessment Conclusion	All students will have read the lab induction RA and COSHH beforehand and signed to acknowledge awareness, demonstrator will go through again highlighting location and nature of risks. All students will wear the required PPE lab coat, lab specs, safety shoes and suitable gloves as set out by COSHH where required. LEV checks are carried out by demonstrators before start of practical on fume hoods/Niederman arms. Students will be supervised at all times by an experienced demonstrator (level 3 operator of equipment) with processes and equipment who will have no hesitation in banning students from all labs if not following instructions or acting in a dangerous manner. All risks are controlled adequately with existing measures.
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Finally, many laboratories in the Energy Innovation Centre have one or more workstations in which obnoxious vapours and fumes are generated, or aggressive chemicals may be encountered. Therefore, local exhaust ventilation (LEV) systems are widespread in WMG laboratories. They vary in many aspects, like size, access to artefacts, sealing level, transparency, lighting arrangements etc. Most importantly, their risk assessments have to clearly the level and nature of the exhaust vapour filtration – i.e. whether the extracted gasses can be polluting or toxic to the atmosphere. Figure 4 illustrates a soldering station made of transparent plastic and equipped with a closely positioned extraction system. For research and development work with more aggressive chemicals and/or that sensitive to contamination, fully enclosed workstations are used, such as the one shown in Figure 5.



Figure 3: Local Exhaust Ventilation system for a soldering station

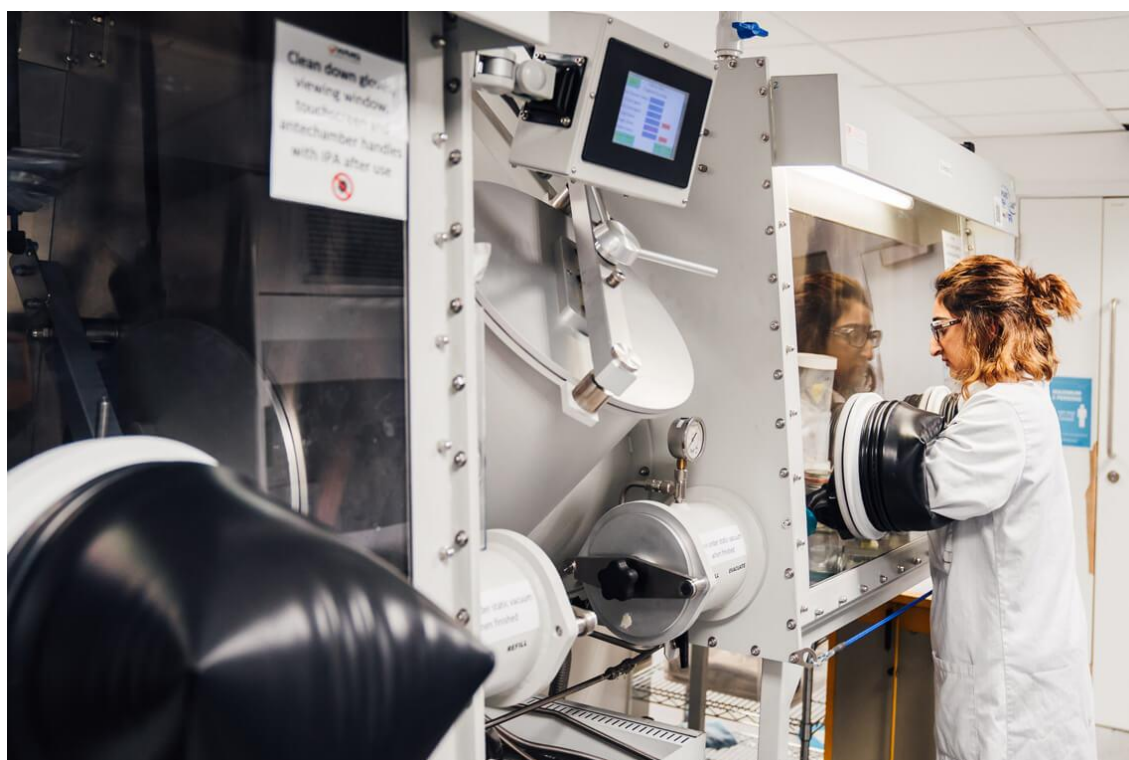


Figure 4: Enclosed chamber for forensic work on Lithium-Ion battery cells.

CONCLUSION

The paper has depicted the overall structure for managing health and safety at work in the University of Warwick and in the WMG Department. This involves every staff and student, who are from the start informed of their well-defined responsibilities and the mandatory training. For any possibly hazardous activity in learning and research, the staff involved have clear guidance and excellent support for H&S Officers. For undergraduate students, the combined approach of their workplace training and practices, the assignment and specific lab briefings reinforces the importance of health and safety at work, as a primary aspect of their engineering careers. For short specialist training courses, health and safety is even more paramount so the WMG staff have developed detailed risk assessment forms for every practical activity.

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