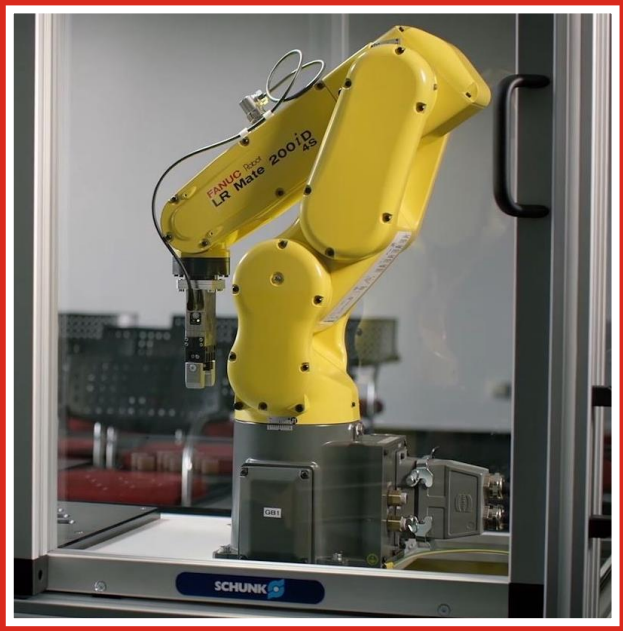
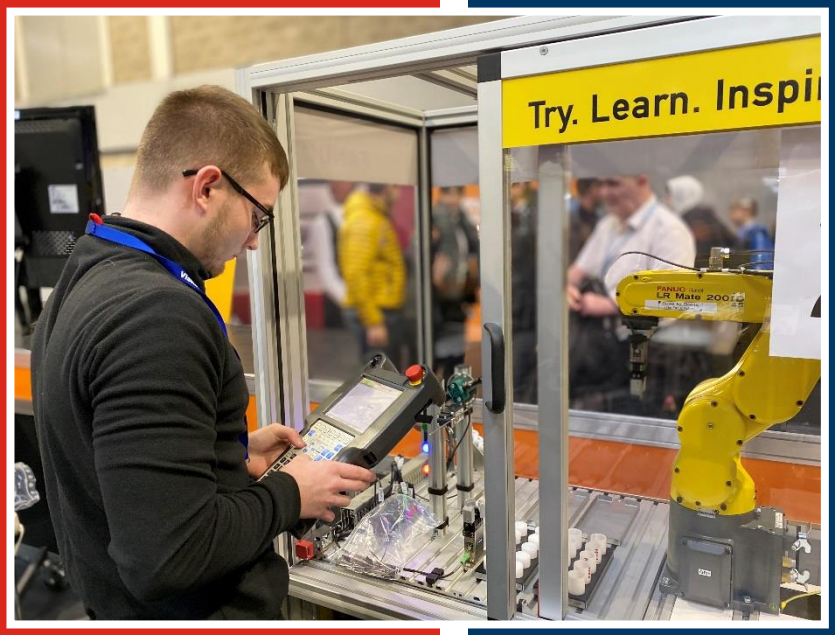
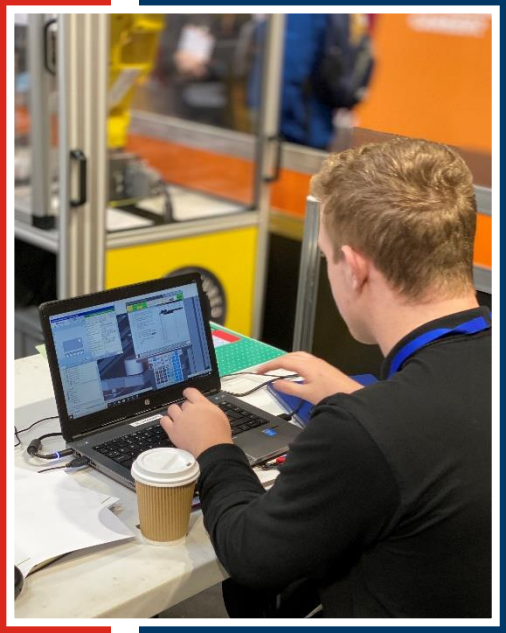
Technical Handbook

Industrial Robotics







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Equipment and Support in partnership with:

Overview:

Industrial Robotics refers to the use of industrial robots in performing automated manufacturing tasks. It allows for outfitting and programming them to work in a wide variety of sectors to include assembly, foundry processes, handling, palletizing, finishing processes, welding to name a few.

Robot integrators need a wide range of skills, both practical and digital, to enable them to carry out roles in:

- robot implementation
- design
- integration of peripheral equipment
- programming
- planning and documentation
- maintenance
- troubleshooting

Automation is a fast growing and innovative field of Engineering, spanning a number of industry sectors that value skills in problem solving, critical thinking and process optimization coupled with high standards and a good work ethic.

Resources and Registration:

For more information on how to register for this competition, the competition rules and the steps involved please visit our website on this **link here.**

Industrial Robotics Career Pathway

What is the job role?

The number of robots used in industry has increased rapidly, with an estimated 400,000 installed every year. A robot integrator ensures that they fit properly in the production process and so that they can perform complex and precise tasks, robots rely on skilled human resources to install and maintain them.

Robot integrators must be able to assess the best type of robot for a particular application, which might include lifting, loading / unloading, or welding, and then deciding where to place them. Other considerations include managing the flow of parts, developing, and installing suitable programming, and the safety of the human workforce around them.

A Robot Integration technician will provide technical solutions to allow them to be integrated into the production process, from the preliminary assessment through to connecting them to power and other automated systems. They should be aware of the latest developments in manufacturing and control systems, including the multi-articulated arm, and the evolution of regulations for robotization.

Typical routes into this type of role include:

- through a related university course
- an apprenticeship
- working towards this role.

General Working Hours and Salary range:

In the UK working hours are generally between 37-40 hours per week, Monday to Friday, though this can vary to include shift work and overtime.

As an apprentice, you can expect to start your first year from around £12,000 per annum with a staged increase depending on performance and stage of training.

Once qualified you could expect to start on around £24,000 per annum, often with the additional benefits of company pension, holiday entitlement and private healthcare schemes. There is normally an element of travel and overtime expected within the role to sites around the UK and abroad.

Future job roles:

These would include progression into roles such as Service Engineer, Project Engineer, Project Management, System Designer, Electrical Engineer or Design Engineer.

Competition Hardware Requirement (Important)

Industrial Robotics is team event open to teams of no more than two people. The first stages of this year's competition have been designed for remote completion and submission. As part of this, you will need to install software onto a suitable device.

Please be aware of the minimum system requirements, listed below, to ensure successful installation and use of this software.

- **Operating System**
  - Windows 10 (32-bit and 64-bit)
  - Windows 8.1 (32-bit and 64-bit)
  - Windows 7 (32-bit and 64-bit)
    (Windows 64-bit version recommended)
- **Processor**
  - Type: AMD Athlon 64 3200+, Pentium IV 2.4 GHz (Core(TM) 2 Quad or higher recommended)
  - Speed: 2.4 GHz
- **System Memory**
  - 1 GB (4GB recommended)
- **Video Card**
  - RAM: 512 MB
  - Resolution: 1280x1024
  - Colour Depth: 24-bit colour
  - Hardware Features: OpenGL Hardware Support
- **Free Hard disk space**
  - 4 GB
- **Additional Hardware**
  - Ethernet, DVD 32x, Mouse

Competition Entry Criteria:

- **this is a team activity (teams of two)**
- there is no limit to the number of teams permitted to enter this competition per organisation
- **competitors must have access to I.T equipment capable of running FANUC Roboguide software (minimum requirement is listed on previous page)**
- teams must be available for the final stage of the competition at the National Finals in November 2021
- **competitors should be within a year of completion if you hold a full level 3 apprenticeship in engineering.**

The competition has been designed to accommodate a range of participants with little to no knowledge of robotic systems, to robotics engineers. Stretch and challenge tasks have been incorporated to maximise a range of skills necessary to operate in a range of robotic engineering environments. Participants will be asked to complete two tasks using virtual simulation software to include design, assembly and offline programming. Successful participants will then be invited to take part in the National finals working and programming with real FANUC robots.

Find your shining stars!

Try and run your own competition activity as part of your teaching and learning programmes. This is a great way to stimulate enthusiasm and interest for competitions.

Competition Structure:

Registration:

Once you have completed your registration, and accepted all terms and conditions, you will be sent a copy of the FANUC Roboguide Simulation software for you to install and familiarise yourself with prior to the release of the Passive Stage task on the 17th May.

Passive Stage:

Following on from closure of the registration period the passive stage task will be a virtual task, released to all entrants on the 17th May with a deadline for submitting it electronically by midday on the 18th of May. You will then be informed, by the end of May, if you have achieved a high enough score to move forward onto the National Qualifier Stage.

National Qualifier Stage:

After being notified of your success, you will need to register the Roboguide simulation software in preparation for the Qualifier Task. Full details of how to do this will be sent to you with your success notification.

You will not be able to produce a simulation for submission in the qualifier stage unless you register the software beforehand so please don't forget to do it!

As with the passive stage the task will be released, in late June, to all successful teams on the same day with a deadline for submitting it electronically 2 days later. This competition stage will also be a virtually led, similarly to the passive stage.

A team of FANUC's Robotics engineers will then mark your team's entry and you will be notified of your results in September. The 6 highest scoring teams will then be invited to take part in the UK Final in November.

Worldskills UK Finals

If your team is successful in the first stages and goes through to the UK Finals these will be held in November 2021. This competition stage will further test your knowledge and skills with virtual and real-world programming using the FANUC Educational Robot cell. The task will combine practical design and assembly of hardware with robot programming in both the real world and virtually. Please note this competition stage is expected to be held at a venue which will be confirmed later. Outlines of examples are provided below to enable you to see the type of tasks you may l be asked to carry out for the different stages. Ask your lecturer / employer for help in any areas where you feel you could improve and try to get some experience before the tasks are released starting in May 2021!

Passive Stage

Designed as a basic introduction to using FANUC Roboguide simulation software the task will be undertaken virtually and would take, ideally, between 1-2 hours to complete. We will be looking for teams who can demonstrate the ability to:

- follow instructions and procedures
- communicate ideas and information
- pay attention to detail
- work effectively together in a team.

This is a team skill competition, with only one entry submission per team. The competition task will be released at 9 am on the 17th May with an electronic submission deadline of 12pm midday on the 18th of May. The entries must be submitted electronically via email to **RSI@fanuc.co.uk.**

National Qualifier Stage:

This task will build on the knowledge gained in the passive stage and require elements of CAD modelling and programming. As with the passive stage it is designed to be take place remotely and would take, ideally, around 10-12 hours to complete.

There will be two parts to the competition to enable both members of the team to contribute towards the final submission. We will be looking for teams who can demonstrate the ability to:

- collect and utilise information
- work effectively together in a team
- follow work instructions and procedures
- produce cad models from engineering drawings
- produce documentation to support your submission
- communicate ideas and information
- extract technical data from manufacturers specifications
- produce a simulation to industry standards.

This is a team competition that requires only one entry submission per team. The competition task will be released in late June with entries being required to be submitted electronically to: **RSI@fanuc.co.uk. The submission deadline will be 5pm two days after you have received the competition task.**

Exact dates along with instructions on how to register the roboguide software will be communicated to successful teams from the passive stage,
in advance of the qualifier stage held in June.

National Qualifier – Industrial Robotics task breakdown:

CAD Modelling

Competitors will be expected to produce 3D solid models from manufacturing drawings. The models will then be imported into the roboguide simulation software for use in the production of a system workcell. In addition, competitors will need to produce a 2D layout of the workcell giving an accurate representation of the cell after the process has been optimized.

CAD Design

Teams will need to design equipment for the end of arm tooling (EOAT) to enable the robot to perform pick and place operations. This will then need to be translated into manufacturing drawings for submission.

Offline Programming

Competitors will be asked to produce offline programs using the Roboguide simulation software to replicate a sequence of material handling operations. Programs should reflect industry best practice in their construction and make good use of the functions available in the software to produce efficient results.

The workcell can then be packaged to submit electronically and will form part of the qualifier task entry submission.

Workcell Optimization

The task will comprise of a combination of machines and robots to form a workcell. It will be up to the teams to optimize this layout to give the best cycle time for a given sequence of operations.

Documentation

Teams will need to submit documentation and drawings to complete their entry alongside a copy of the roboguide workcell created. The documents should be expected to include:

- 2D layout drawings
- solid models
- set-up / production data
- detailed program structure
- duty estimation.

All documentation is to be submitted at the same time as the packaged simulation cell and will form part of the overall marking scheme. A breakdown of how the marks are awarded is provided below.

National Qualifiers: Marking and Assessment

The competition marking structure is comprised of two main parts to enable both competitors to contribute towards the final entry submission.

One part concentrates on the CAD design and documentation aspect whilst the other focuses on the roboguide / programming element. Both parts are required for a successful competition entry.

Judges are primarily looking for technical competency but will also be briefed to look for excellence amongst competitors and will therefore take into account skills such as:

- quality and attention to detail
- following health and safety guidelines for automation work areas
- communicating ideas and information
- organisation and preparing technical reports
- use of available technologies
- problem solving

All task marking is objective and based on agreed criteria with overall weightings as detailed below:

CAD design & solid modelling	20%
Implementing technical data	5%
Planning & organising work activities	15%
Documenting & recording technical data	15%
Programming & optimization	45%

Competitors will need to ensure that they have registered their Roboguide software to the full version before the task is released. Details will be sent along with confirmation of progression from the passive stage submission.

When the task is released in June it will include an outline of the workcell to be constructed, technical specifications and manuals, manufacturing drawings and any solid models, if not already available in the in-built library, required to enable you to complete the task.

The expected number of hours required to complete the task is 10 – 12 hours. All submitted entries will need to be clearly identified by the team's name and, ideally, sent together in one submission to:

RSI@fanuc.co.uk

Where file size becomes an issue, please contact the email address above to make us aware and we will work through the issues with you to make sure all of your entry is received.

WorldSkills UK Finals – Industrial Robotics task breakdown:

The Industrial Robotics Skills competition will be judged by a panel of robotics engineers & specialists.

The judges' decisions will be independently moderated, and quality assured before being confirmed at the closing ceremony where the results are announced. The judges are briefed on assessment procedures prior to the competition.

Judges are looking for technical competency but are also briefed to look for excellence amongst competitors and will therefore consider skills such as time management, working under pressure and communication skills. All marking is objective and based on agreed criteria.

Building on the skills gained in the first two stages there will be elements of offline programming, CAD and documentation with one additional part – competitors will get to put their work into practice, in the real world, with the FANUC Education cell robots.

The education cell features one of the smaller robots in the FANUC family fitted inside a purpose-built cell. Competitors will be expected to install additional hardware then connect and configure it to work as part of the robot's program.

Roboguide will still play an integral part in the design and optimisation of the cell layout and work as a digital twin to form part of the final submission. As with previous stages, an amount of documentation may also be required as part of the final entry.

Judges will also be looking for other skills expected of a successful team such as:

- time management
- performance when working under pressure
- communication skills
- collecting and utilising information
- planning and organising work activities
- team work
- problems solving
- use of current technology
- effective use of individual's skill-set within the team

All competitors will receive feedback after the competition on their performance.

For teams that complete the main task with sufficient time there will be a further extension task that can be undertaken. This will make use of the iRVision system that forms part of the education cell and work to utilise it to further to enhance the process and complexity of the automated system in carrying out the main task. It will also form part of the overall marking scheme weightings for the competition.

Details of the extension task, as well as all the information necessary to enable competitors to complete the main task, will be given to all teams for two hours of planning and discussion prior to the start of the competition.

UK National Finals: Marking and Assessment

As with the qualifier stage, the competition marking structure is comprised of two main parts to enable both competitors to contribute towards the final entry submission. The finals will differ from the qualifiers as it will involve physically based competition activity.

One part concentrates on the CAD design and documentation aspect whilst the other focuses on the roboguide / programming element. Both parts are required for a successful competition entry.

The extension task enables competitors to add to their score and further demonstrate their technical abilities and skills.

Judges are primarily looking for technical competency but will also be briefed to look for excellence amongst competitors and will therefore take into account skills such as:

- quality and attention to detail
- following health and safety guidelines for automation work areas
- communicating ideas and information
- organisation and preparing technical reports
- use of available technologies
- problem solving

All task marking is objective and based on agreed criteria with overall weightings as detailed below:

CAD design & solid modelling	20%
Implementing technical data	5%
Planning & organising work activities	5%
Documenting & recording technical data	10%
Programming & optimization	45%
iRVision	15%

All equipment, tools and specific safety equipment for use in the UK Final will be supplied to the competitors and no additional documentation or devices will be allowed during the competition phase. If supplied, all competitors are required to wear any competitor work wear during the competition days. Please bring your own safety shoes. (Without your safety shoes you may not be able to take part in the competition due to health and safety regulations).

Any team that is invited to the final who have any special equipment requirements. must notify the competition organisers prior to attending so that they can assess your request and make any adjustments to the equipment supplied accordingly.

UK National Finals: what to expect

Please note, some dates may be subject to change. The competition is structured to run over four days:

- Wednesday 17th November, this will be used for familiarisation, training, equipment checks and to cover the health & safety considerations that arise when working with industrial robots. Details of the competition task, and the extension task, will be given to teams for two hours of planning and discussion before the end of the day. Any notes or information generated during this time will remain in the competition area until the following day.

- The next two days, 18th & 19th November, are for the competition itself. Submission of the team's entry, including any specified documentation or data, will be at the end of the second day.

- Saturday 20th November is a chance for competitors to showcase their knowledge and skills without the pressure of competition. There will, hopefully, be the opportunity for competitors to become a trainer for the day and invite the public to 'have a go' on the competition stand programming and operating the FANUC robots.

Training for the UK Finals

Following the release of results for the qualifier stage in September the six finalist teams will be given the opportunity to attend a training event*. This will give successful teams a chance to work with FANUC robot engineers and learn the basic Health & Safety considerations when working with industrial robots.

Teams will also be able to ask questions regarding industry best practice for producing operating programs and allow them to explore the options and technology in-built to the robot controller in preparation for the final.

The training will be in the form of a one-day event at the FANUC UK head office in Coventry* and will look to cover:

- working safely with industrial robots
- advanced options
- iRVision set-up and operation
- industry best practice
- program layout & optimization

Live training events are dependent on following government guidelines around the recent pandemic and subject to change

Competition Rules

Conduct for competitors during live competitions:

- it is the competitor's responsibility to arrive on time at the event each day, late arrivals may be excluded from the competition.
- FANUC UK will provide accommodation for you from the Wednesday to the Sunday
- competitors will start and finish tasks as instructed by the judges or competition team
- equipment, tools and specific safety equipment will be supplied; however, competitors are required to wear any competitor work wear supplied. Please bring your own safety shoes. (Without your safety shoes you may not be able to take part in the competition due to health and safety regulations)
- any competitor who wishes to leave the area during the competition must seek the permission of the competition organisers or lead judge
- if there is a power stoppage, breakdown of machinery or accident, the competitors must act according to the instructions of the competition organisers
- competitors are expected to comply with the host venue rules and regulations
- no competitors will be allowed to bring their own mobile phones, laptops or other devices with them into the competition, any competitor found in breach of this will automatically disqualify both themselves and their team from the competition
- at the end of each day of competition, all documentation and equipment for each team will be secured within the workcell or competition area to prevent tampering or loss
- any special equipment requirements must be agreed with by the competition organisers prior to attending the competition. If you do not follow this stipulation, the organisers reserve the right to refuse its use during the competition
- the competition area is a working environment and competitors are expected to conduct themselves accordingly
- please report and problems or damage to equipment as soon as possible to the competition organisers so that they can carry out any repairs or replacements required – it will only harm your ability to produce a final entry submission for the competition.

Judges Top Tips

Preparation and Practice:

- a successful competitor you need to be confident, calm and self-assured when competing.
- prepare by practicing your skills and techniques to ensure you get the required standard/results you want without any surprises.

Time Management:

- learn to manage your time effectively when completing tasks by working smart not fast
- the tasks have allocated times, so practice working to time and under pressure to perfect your timing. If you run out of time in the competition you will lose marks.

Planning:

- make your own plans for how to complete each task, work methodically and even write it down to help you prepare.

Organised:

- make sure you are organised, make sure all stages of a task are completed
- organise all of your equipment and materials for the task.

Health & Safety:

- in any engineering environment health & safety is very important, make sure you use the appropriate PPE for the task and work safely.

Clean and Tidy:

- keep your working area as tidy as you can be more efficient in a tidy work area. Make sure that when you present your work to the judges it is clean and ready for final judging.

Understanding:

- read the task brief thoroughly and make sure you understand what you need to do
- do not be afraid to ask questions, remember there is only one silly question…the one you don't ask!

Don't Worry:

- if a part of a task hasn't gone as well as you might have wanted don't worry or dwell on it, just draw a line under that and get on with the next task.
- always focus on the marks you can gain not what you might have lost.

Enjoy:

- getting to the WorldSkills UK National Qualifiers or the WorldSkills UK National Finals is in itself a massive achievement that you should be extremely proud of - make the most of the whole WorldSkills UK/IR Skills Competitions process and enjoy it!

Ask:

- if you are invited to the UK Finals and able to take advantage of the training Day with some of the FANUC engineers, make a list of questions and be sure to ask them on the day to find out what is meant by industry best practice, safety around robots & process optimisation to make sure you are as prepared as possible to compete in November.

Digital Resources

If you don't have access to CAD software, such as Solidworks or ProEngineer, a number of alternatives are given below some sites make use of online platforms whilst others are downloadable software. All will give you the capability to transfer your models for use in Roboguide, some are more advanced and can be used to produce assemblies:

- **freecadweb.org**
- **tinkercard.com**
- **autodesk.co.uk** (most Autodesk software is free for students)
- **openscad.org**
- **sketchup.com**

Most of them have in-built tutorials that you can use to practice your modelling skills before the release of the competition tasks.

Additionally, there is the facility, within Roboguide, to create parts and models that can then be used in your simulations. To use this function when you first install the Roboguide software you would need to check the 'Modeler' option plug-in.

Beyond the UK National Finals

Please note: 2021 will not be a selection year for the international competitions.

The industrial robotics national finals also form part of the selection process for WorldSkills international competitions. Training managers are usually onsite during the competition, monitoring the performance of those who are age eligible and who show the highest skills, passion, and drive to compete and could be invited to form part of the UK Squad.

Further details of the international competitions, including eligibility criteria and other opportunities you can get involved with, can be found on the **WorldSkills International website.**

You will be notified if you are age eligible following the UK Finals.

Those who are not eligible for WorldSkills competitions may join the Champions programme, which allows continued involvement, including the opportunity to work with WorldSkills UK and visit schools, colleges, and events to inspire the next generations.

Alternatively, if training is of interest to you, you could consider supporting WorldSkills UK with organising and training, and even helping to run the national finals.

Get inspired and become a part of Team UK today!

FANUC