WorldSkills UK
Manufacturing Team Challenge
Technical handbook

Competition overview

The MTC requires a team of three people competing as complementary specialists, combining skills such as project management, electronics, programming, machining and computer aided design. Time, cost and quality are all factors in the competition; in addition to individual talents, participants must contribute to the team as a whole, showing self-awareness, interpersonal skills, and thinking outside the boundaries of their own area of expertise.

Teams may be made from any complimentary specialisms and it is normal to train them in the areas they are deficient.

For example a team may comprise of an Electronics specialist, a CAD specialist and a Machining Specialist.

This team would require some training in Welding and Fabrication as well as fitting and any other specific elements the particular project requires. This will differ depending on design.

The competition welcomes any FE or HE level entrants, but normally teams comprise of individuals trained or training at least level 2 in the practical elements and level 3 in theoretical elements.

The ideal team will have a mix of hands on practical members capable of completing the surprise elements, and higher level attributes capable of completing the design and calculations, producing ISO standard drawings and being able to problem solve, adapt and overcome issues as and when they arise.

Stages of the competition

The stages ahead are as follows:

1. Passive stage- The passive stage is designed as an introduction to manufacturing concepts as well as three core skills. This is to be completed by the 29th April. This can be done in one day, plus some time for thought and design of manufacturing processes. This gives the opportunity for feedback and perhaps some insight into changes and ideas you may want to employ in the later stages.
2. Registration closes.
3. Within 1-2 weeks all teams will be sent a video link to a YouTube video giving abriefing for the assigned task.

4. Each team will be given the chance for a virtual meeting to ask questions and go through any areas they are uncertain about. This will occur by the end of April.
5. From April to June: all teams will participate in the national qualifier round. This will be a virtually led round for 2022. (See below for details ofthe requirements.) The top scoring teams will then get through to the next round, the national finals.
6. In July, WorldSkills UK will announce the finalists who will be invited to thenational finals event to compete. 1 or 2 teams may be asked to hold in reserve in case teams drop out.
7. The national finals event will take place, with Gold, Silver and Bronze awarded to the top 3 scoring teams.

The national qualifiers

In order to keep your design secret from other potential competitors you will be required to be virtually assessed as a team against the brief. For this there will be no requirement for surprise elements but everything else will be assessed.

The Main Project

A working prototype will be assessed against the brief criteria. Not all tests may be exact, for example, it is not possible to transport a course around the UK, so elements of this may be assessed to find a grade.

This does not have to be built while being assessed but should be built and fully operational ready for when the Judge assessment. Much like the Death Star, it may be fully operational but not be the finished article at this time! It must be noted, it will be judged in somewhat of a comparison against all other teams' projects entered. This simply means the more it does and the better it is made, the more likely you are to progress.

Portfolio A

This should be complete at this time to be marked.

Portfolio B

This should be complete at this time to be marked.

Costings

A cost for raw materials should be presented along with an estimate of working time and machinery usage. These will be costed and compared to all other teams in the qualifying round.

The National Finals

The final score from the national qualifiers will determine who goes to the national finals event, the top 6 are invited and 2 reserve teams may also have an opportunity to compete.

Career pathways

The broad nature of this competition lends itself to many career paths. Not only based on the three principle areas of Electronics, Welding and fabrication and machining, but various other areas that the competition convers.

Common areas include, but are not limited to:

Electronics technician: Electronics Technicians design electronic components, and repair, install, service, and update existing electronic systems. They may write reports and manuals, and perform their duties in offices, factories, telecommunications industries, and various other settings where electronics are used.

Electronic design: Research, design, develop, or test electronic components and systems for commercial, industrial, military, or scientific use employing knowledge of electronic theory and materials properties. Design electronic circuits and components for use in fields such as telecommunications, aerospace guidance and propulsion control, acoustics, or instruments and controls

Embedded system programmer: Designing and implementing software of embedded devices and systems. Designing, developing, coding, testing and debugging system software. Analysing and enhancing efficiency, stability and scalability of system resources

PCB design: Printed circuit board designers use computer-aided design (CAD) tools to build circuitry that will be assembled onto these boards and to specify how the connections will be arranged. As reported in 2019 job listings from *CareerBuilder.com*, some designers develop the digital or analogue designs while others work on the routing layout. They make sure that the final draft works as expected and meets industry requirements before a design is sent to the manufacturing facility where the PCB will be fabricated.

Machinist: Turning: **Turners** are responsible for manufacturing metal components and assembling them to construct tools, industrial machinery, and machine components. They study assembly specifications to perform the most efficient order of processes required for specific projects. These specialists also measure each large and small component to ensure they will fit together properly in the final design. They identify potential problems by understanding machine specifications and drawings before the production process

Tool room general machinist: As above but may include working on a Conventional or CNC Milling machine also.

Welding technician: Welders manage the machines that manufacture and repair metal structures, tools, and equipment. These skilled professionals work in a variety of industries including automotive, construction, and manufacturing. Other duties include planning layouts and measurements and testing welded surfaces

Sheet metal work fabricator: sometimes called *precision sheet metal workers*, make precision sheet metal parts for a variety of industries, from power generation to medical device manufacturing. Most work in shops and factories, operating tools and equipment. In large-scale manufacturing, the work may be highly automated and repetitive. Many fabrication shops have automated machinery, such as computer-controlled saws, lasers, shears, and presses, which measure, cut, bend, and fasten pieces of sheet metal.

CAD operator: A CAD operator, also known as a drafter, uses computer-aided design or CAD systems to make drawings and blueprints which can be used in building designs, machinery designs, landscape designs and anything else that requires a design prior to being constructed

Manufacturing Engineer: Develops and improves manufacturing processes by studying product and manufacturing methods. Develops manufacturing processes by studying product requirements; researching, designing, modifying, and testing manufacturing methods and equipment; conferring with equipment vendors. Improves manufacturing efficiency by analysing and planning work flow, space requirements, and equipment layout.

Design Engineer: Design engineers' study, research and develop ideas for new products and systems used to make them. They also modify products or processes to increase efficiency or improve performance. They work on almost every consumer product imaginable for large-scale production, from telephones and medical equipment to kitchen appliances and car engines.

Production Engineer: Production Engineers are responsible for supervising and improving production at plants and factories. They support engineering teams, draw up safety protocols, report issues to the Manager, and develop strategies to improve efficiency and profit.

The competition is also very useful in satisfying project requirements for BTEC, HNC, HND and degree courses. These usually require a design and build project, such as the competition. The MTC allows these designs to have real world test, build and experience valuable in the critique of the final submission.

Pre-competition activity

The brief details the activities to be completed before the competition:

- section A of the portfolio; To be handed in on familiarisation day
- purchase of all permissible raw materials, components and fasteners needed by the team to manufacture their Main Project

- materials may be rough cut into billets, or length but may not be machined to size but must be a minimum of 50mm longer than the required size for lengths of materials and 50mm longer and wider for sheet materials. Burrs or sharp edges are to be removed
- manufacture of electronic circuit boards, but these boards may not have components mounted before the Competition
- section B draft must be handed in on familiarisation day for experts to use for the materials and toolbox check
- section B may also be brought for competitors use but must be on coloured paper and labelled draft.

However, in addition to this each team will need to have:

- completed a full design
- constructed a prototype
- fully tested the prototype
- refined the design
- practice built to a schedule the design
- refined build time to optimise the construction of the project
- practiced working to the standards in each individual surprise project element.

Digital training resources

- WorldSkills UK Live: MTC 20xx Briefing Video. The link will be emailed to all competition entrants directly. However, subscribing to the **United Kingdom MTC video channel** on YouTube you can access this and other support videos.
- Join the Google Classroom: To join the Classroom go to classroom.google.com, click on Join and enter using code: **7v4g6q2**

Where you will find:

- WorldSkills UK LIVE Guide to the MTC competition.
- **WorldSkills UK Live MTC Portfolio B support Video link**
- Template spreadsheet for all raw materials
- Example competition booking sheets
- Flowcode 8 Instructional video links, for those seeking support with programming
- Google resources video link to help use the google classroom.

For competition information, further resources including how to register, competition rules and steps for competing, visit our website.

Top tips from judges

I am not going to give everything away that is used by the UK teams and certainly not in writing, but there are lots of common areas all International teams exploit that may be useful to you also.

Firstly I would say the rules are there to prevent unfair practices in competition.

Anything not covered by the rules is not unfair! Using the rules to your advantage shows understanding not unfair practices.

The rules can be found in the Technical Description, but this needs to be read carefully, interpreted very literally and sometimes I need a translator too. But this is all the applicable rules that can be very time consuming to read, but valuable to improve competitiveness.

TIP 1) Preparation, preparation and when you think you are prepared do some preparation.

Is it advantageous to have all raw materials prepared to be an exact size plus 50mm or more above the required size. By all this truly means all, but remember, supplied as a length then 50mm in one plane, as a sheet then 50mm in two.

It does take time and money prior to the competition as it generates waste, but you only have to set the machine back stop once for the guillotine and once for the cut-off/bandsaw.

If you're the first team on you will have to set the machines up, if you're the second you may be lucky as a team may be kind enough to have left it for you already set. Best check though! This can save a lot of time in set up, which translates to man hours and machine hire costs. It can also mean you finish early and have a much better product.

TIP 2) Jigs and fixtures.

This adds to toolbox weight so how they are made needs careful consideration. But combine it with the above tip and this means you should never have to mark out anything.

This is a manufacturing competition, so think mass manufacture. Apply Kaizen and Poke Yoke principles and you should never have to mark out anything and checks should be very quick and simple.

TIP 3) Practice build and schedule.

A good well-known schedule is key to success. It must be rigid enough to know exactly how and who for every operation, but flexible enough to allow for mistakes, rework and not being able to get on equipment when you want to.

TIP 4) Design down to the minimum.

What are the least materials and operations you can get away with?

How many common components can be used (this also saves on Jigs)?

Is there something available that can be modified to do the job instead of making it?

Can you use components that cannot be made at the competition using hand tools and the supplied machinery? (Cogs, motors and wheels for example are common ones.)

Design it to last for the competition, not for the next few hundred years.

All of the above affects either cost of materials or time or project weight and can have implications on all of those categories.

TIP 5) Programming time

Programming can be long-winded and laborious, but some methods are faster than others. Pay special consideration to this when choosing how to program the LCD and associated microprocessor. E.g. Arduino IDE is much faster than C++ and you can use any legitimate library from the manufacturer of the LCD or other microprocessor-controlled device, or any that is already built into the software for the programming methods you are using.

TIP 6) Logistics

To get from your bay to the welding booth, bandsaw, pillar drill etc. does not happen instantaneously. Plan in logistics and plan who; some operations may require 2 people for speed and efficiency. E.g. using a pillar drill to make several hundred holes. One person can be fitting jigs and passing materials to the second operating the drill. They can also sort and move back to the build bay the materials finished with.

This does not always have a benefit, it depends on your build, so consider this kind of thing carefully.

TIP 7) More logistics

How are you going to carry materials back and forward from the build bay to machinery?

You may only have one metal bar going to the lathe, so this is easy.

What about going to the Bandsaw with 30 pieces of metal.

TIP 8) One man one job

Unless you work for the council and it is the 1950's this is unlikely to happen at work, so why let it happen in the competition.

Cross training allows the best to take a lead on things, but if they run behind or experience problems another can fill in to keep the project running forward closer to schedule. This also saves on having people sitting around waiting for the third to finish before they can continue their own tasks.

TIP 9) Getting the portfolio A and Drawings portfolio B right

Before you enter the competition, you can gain points with no worry on the day.

Getting the drawing order right so one drawing is simple edits to the next, having a set template for drawings with most of the information pre-filled and lots of practice in doing them saves a lot of time and scores a lot of marks. Inventor is free to download for education (use your college email address to register with AutoDesk), so what else are evenings and weekends for?

TIP 10) Never assume

Teams often assume they have the cheapest raw material cost, then score zero as others are much cheaper. Teams think they are going to finish first in one day, (only ever done once in the history of the UK competition), then struggle to finish by day two end.

Your solution might be the best and the cheapest, until someone else's is better and cheaper, so never stop looking at ways to improve or ways to cut costs.

TIP 11) PPE

Full PPE on at all times when on stand. A judge will not likely stop you unless what you are or are not doing is dangerous, they will just quietly mark down the penalty.

Overalls, or separates are fine, but on at all times, safety goggles, gloves where applicable and safety boots. Without all of those on at all times on the stand you may be stopped working or incur penalties.

TIP 12) Know the brief!

The brief tells you everything, what your product should be able to do, what the judges will be looking for, how it will be marked and what will lose marks.

So far the closest scores between Gold and Silver has been 0.15 marks in 2019. Could the Silver team have pulled that up by hitting just one more tiny part mark and taken Gold instead? This is less than the mark loss for Judges finding a burr on metal.

Not only does the brief tell you what and how criteria will be marked, but it also tells you the marking order and what days they will be marked on. So, when you are testing your final design, use this as a guide and test in that exact order to see if one test is causing a problem to another. The test course and items are also there; would it be a good idea to use things close to this for a test, where possible even recreate them?

TIP 13) Have a good long natter with your friends who have come to support you.

It is always good to waste the time you have chatting about last night's episode of Big Brother or Love Island, that way when you don't finish the product and surprise elements you can have someone else to blame. Obviously, this is not a good idea!

My advice is: pre-warn supporters you will not be speaking to them, if the public speaks politely tell them you are too busy to chat, or, if you must chat, clock off the working time till you have finished. If not the conversational starter of "we wos robbed" might not apply to football for a change. Note: no judge will ever stop you wasting your own time, they will probably have a quiet chuckle to themselves though.

TIP 14) Break it all

Schedule and take breaks, these help you recharge and actually mean you work faster when you do, but you still only have the same limited time. So best plan for a simpler design to build than you thought to get these in.

TIP 15) Bring your mums marigolds.

A clean tidy well laid out build bay is the most invaluable resource in your control.

Each bay will be approximately 4x5M and will contain 1 chair with a computer workstation and computer. 1 electronics bench approx. 1.2M long with a chair. 2 workbenches approx. 1.2M long, one fitted with a vice. There will also be wall space and floor space.

A clean, simple layout for tools and materials gains much time and ease. Returning all tools to one set area for that tool means everyone can find it, including you! I see teams bumbling about looking for tools all the time.

Similarly a place for all materials, perhaps one for pre-cut and formed and one for after helps. The floor leads to tripping over a lot, but that is entertaining!

Lastly you get penalties for untidy or dirty build bays, this is recorded just before lunch and at days end every day during all competitions. There are so many ways to do all of this, some work for some, others for others, but whatever works for you, get it right and practice using that layout.

TIP 16) Have fun

It is a lot of work, tough competition and maybe only the start to a great journey, enjoying it makes it so much easier!

TIP 17) Win gold

Of all entrants only 1 team can do that, but they are always the happiest leaving. Silver and Bronze medallists are nearly as happy, but everyone else, well, not so much. But Gold is for every team to win or lose, time planning and effort are the biggest determining factors, though of course good design plays a part, but no more than good preparation!

TIP 18) Use your resources well

The more serious side of this is that I am a resource to be utilised during your preparation. My email is the best way to get in touch, though the phone is also viable. Anything at all, just drop me a line with a question, or to sound out an idea you are unsure of, advice on a problem you cannot solve, and I will do my best to get back to you as quickly as I can.

Note: if you are ever sending drawings please do so as a PDF.

Guide to marks and how they are awarded

There are 4 key components to the MTC and the marking scheme is broken down into these four areas:

1) The Main Project:

The main project is defined by the **brief** and usually consists of a **design and build** challenge with a series of tests to check conformity against the brief specification.

This is worth around 40% of the marks but does vary.

2) Portfolio A and B:

Portfolio A will be specified in the brief and asks for a **video** of elements of the project and some **paperwork** regarding the project; such as a manual or troubleshooting guide, and other related material.

Portfolio B consists of **drawings** created using CAD and E-CAD.

This is worth around 20% of the marks but can vary.

3) Costings:

This is the cost of **raw materials**, the theoretical cost of manpower for the competition and the cost of theoretical hire of certain machinery.

This is worth either 10% or 5% of the marks, depending on the project.

4) Surprise Projects:

These are unseen projects to be undertaken by competitors that test 3 areas: **Electronics** assembly and manufacture, **Fabrication** with MIG welding, (though TIG is an available option), and **Turning**.

This is worth 30% of the marks.

There are three broad types of assessment. Objective, judgement and comparative.

Objective assessment

This is a simple yes or no criteria. The brief will specify the assessment method in detail as to how the project or portfolio will be assessed. It will ask for the project to be able to demonstrate a particular function or ask for a particular element to be included in one of the portfolios.

If the criteria asked for can be demonstrated in the way asked for, or the Portfolio's contain the asked for information, the mark will be given.

Surprise projects also have most of their marks allocated this way.

It is extremely important to ensure that the project can do the asked function in the prescribed way.

It is also critical to ensure to portfolio has exactly what is asked for. In a portfolio using the heading from the brief is not necessary but will ensure that it is seen as being the information asked for.

Judgement assessment

This follows a set structure. Each judge will award:

0 Does not meet industry standard

1 Meets industry Standard

2 Meets market Standard

3 Meets and exceeds market standard.

Each of these marks will be totalled to give the proportion of the available marks to be awarded.

E.G. Judge 1 awards a 2, Judge 2 awards a 3, judge 3 awards a 2. The total is 7 from a possible nine. There for 7/9ths of the marks available will be awarded.

Comparative assessment

This type of assessment is only used for the main project and costings.

The main project uses this type of assessment as follows:

The best performing team will receive the full mark available. The lowest performing team will receive 0 marks. All other teams will be graded proportionally between the top and bottom teams.

Examples: Fastest to complete the time trial, lowest weight or heaviest weight lifted.

The costings section uses this type of assessment as follows:

The lowest cost after adjustment by compliance sets the benchmark value and receives full marks.

This number is then doubled. From 100% more expensive onwards the score will be 0. Between the benchmark value and 2 x the benchmark value, the team will receive a proportional grade to this.

Compliance

This is the main project marks as a percentage. This adjusts the costings proportionally to the mark. The lower the score in the main project, the higher the costings become. See brief for details.

4 Competition

4.1 Costings

The costings marks will be calculated by comparing team's build cost, build time, machinery hire costs and compliance to project specifications.

Marking will be on the basis of product cost and will include Competitors' work time, materials used, components used, any consulting fees, and machine tool and tooling costs. Required tolerances must be met for a result to be valid. Note: any penalties applied are applied to the costings. The list of penalties can be found in the brief.

Each team must make sure to record the time they start and finish each shift and clearly indicate what activity they are working on (for machine costs).

Main Project labour hours and machine usage hours will be costed at an hourly rate. This hourly rate will be calculated in Euros.

Hourly rates are:

- each teams working time: €90.00/person/hour
- for using workshop equipment, e.g. welding, grinding, sheet metalwork, pillar drill and saw: 15 €/hour
- for using a lathe: 25 €/hour
- consultant and training @ €40.00/hour.

Sections of the portfolio must be done during the Competition and will be costed as working time.

There may be other forms of assessment for sub-categories of the Main Project such as cycle time where applicable which may also translate to cost per product item made and inclusion of specific items of documentation. Multiple awards may be made.

The time taken to complete any surprise projects will also count for machinery hire and Labour costs, but not for Raw Material Costs.

4.2 Raw material costs.

The components for the main project that are supplied by the team must be fully costed. For most components this will be at a cost found on an online catalogue with a weblink inserted in to the spreadsheet that can be used to verify this cost.

For Raw materials the cost is fixed and must be applied as follows:

- Mild steel - 7€/Kg
- Aluminium -10€/Kg
- Brass - 37€/Kg
- Stainless Steel - 28€/Kg
- Plastic - 20€/Kg
- PCB – 0.50€/cm^2
- Batteries, PB, NiCd, NiMh – 0.50€/Wh
- Batteries, Lithium 1€/Wh

All raw material purchased by length must be brought to the competition at least 50mm longer than the size required.

All raw material purchased by sheet must be brought to the competition at least 50mm oversize in two sides so as two cuts must be made.

The template spreadsheet given on the google classroom must be used correctly for marks to be given.

4.3 Time Keeping

Machines are to be booked and allocated in 15 minutes increments.

Standard machine booking sheets to be used during competition are provided on the google classroom for practice purposes. Working hours and actual machine usage hours are calculated to the accuracy of the handwritten time-keeping system. Failure of a team to book off for lunch or a break will result in the cost of that time being incurred.

The minimum increment for consultant time is 15 minutes.

Time keeping is handwritten by the Experts and teams are responsible for ensuring the correct bookings and times are recorded. The time keeping is done with three-minute tolerances.

Standard time sheets to be used during competition are provided on the google classroom and will be provided at the competition.

After a machine usage, the Competitor or team must clean down the machinery. This is done during booked time and it will be costed. Expert will check the cleanliness before the Competitor can leave the machine. Swarf trays are not required to be emptied, but all other areas should be free of swarf.

4.4 Portfolio A

Portfolio A is to be presented on a memory stick, clearly labelled with the team name, on familiarisation day. This includes:

Video in the format listed in the brief. This will be checked and where it meets the requirements, displayed to the public during the competition.

Portfolio A in digital format containing all information asked for in the brief. This should be in PDF format.

Costings spreadsheet, containing a full list of all materials and components used in the construction of the product. This should be in Excel format.

A full list and pictures of Jigs and Fixtures the team intend to use.

4.5 Portfolio B

Portfolio B is to be presented as a printed copy on coloured paper, clearly labelled ‘Draft’ and with the team name, on familiarisation day. This includes:

All 2D detail drawings

All 3D assembly drawings

All welding assembly drawings

All electrical schematics

Any other drawings the team wish to use during the competition

4.6 Toolbox check

A toolbox check will be conducted to check that materials are oversized as specified in section 4.2, all components brought have not been modified prior to competition, jigs and fixtures are coloured red and shown clearly in portfolio A. Any item found that is banned from the competition, modified in any way, or not meeting the oversize requirement will be removed or a time penalty added at the judge's discretion.

4.7 Test Project design requirements

The total working time for the Test Project and Surprise Projects will be a maximum of 16 team hours.

Design

The task is to have all design work including process parts, jigs, and fixtures carried out in accordance with the instructions, specifications, drawings and parts, to the standard required by the brief.

Programme generation

Generate all programmes required for the automated sections of the task during the competition time on software of the team's choice.

Manufacture

Make any surprise projects as well as those parts needed for the working of the test project

Assembly

Assemble the various components either purchased or manufactured during the competition as part of the task.

Optimisation

Revise the manufacturing and assembly process to optimise cycle times and reduce the process cost.

Documentation

Document the process including header page, index, and descriptive overview of the task, hard copy of any programs, instructions for setting up and assembly, and any relevant drawings.

Surprise project

The Surprise Test Projects will be of three categories:

Electronics – The construction and commissioning of a kit, supplied with any combination of instructions, schematics or layout diagrams. The marking scheme shall test function, soldering quality, conformity to layout and neatness of work.

Fabrication and weld- Construction of a fabricated part or parts with some welding required. Teams will be free to choose from MIG and TIG welding. The part or parts shall be made of mild steel sheet to a maximum of #1.6mm and other mild steel extrusions, sections or components as supplied. The marking scheme shall test for conformity to drawing, work to set tolerances given on the drawings, weld quality, porosity, undercutting and weld cracking.

Manual Turning- A single or pair of parts shall be turned as specified in the drawing given. Diameters will normally be asked to a tolerance of 0.05mm, lengths to a tolerance of 0.1mm. The part(s) maybe designed in a way to ask the machinist to carefully consider the order of work. The marking scheme shall test for conformity to drawing, conformity to tolerances and finish quality.

5 Competition rules

- all competitors are required to wear appropriate PPE when on stand and when using any equipment
- competitors must adhere to the health and safety regulations of the venue and of the stand
- competitors are required to bring to competition all materials and tools required to build their project
- the maximum time for all competition activities is 16-team hours, 48-man hours
- teams must provide, the full portfolio A with costings spreadsheet and video on familiarisation day
- teams must provide a draft copy of portfolio B, printed on coloured paper and marked ‘Draft’ on familiarisation day, prior to toolbox check
- teams may bring as many Draft copies of Portfolio B as required but must be supplied on coloured paper and marked ‘Draft’
- portfolio B completed during the competition must be handed in for judges to mark by 12PM on day two of competition using only the USB stick provided
- all surprise projects must be handed in for judges to mark by 5PM on day two of competition
- judges may extend the working time at their discretion to account for equipment malfunctions, loss of power and other extenuating circumstances
- no component may be modified prior to the start of competition
- any component that can be made during the competition must be made and cannot be purchased as a component
- any component that can be substituted for an item that can be made, must be. E.G. a linear actuator can be substituted for a lead screw assembly that can be manufactured during the competition

- 25% of electronics may be preassembled by number of components. This does not include LCD panels which may be purchased outside of this count. This is to allow multi-component sensors etc to be used
- the brief details Equipment and Materials not permitted. These items will not be allowed on stand
- judges' decisions are final.

Further Guidance can be found in the WorldSkills UK- MTC Technical handbook Guide