Making an impact in the manufacturing industry

Explore careers in manufacturing

UK Manufacturing is open for business

Professor Mark Jolly
Director of Manufacturing

A recent report published by Barclays states that if the UK manufacturing sector can attract the skilled, versatile and bright young people it needs, it has the potential to grow by over £18 billion by 2023.

With the government initiative, Made Smarter (a £30m competition for research and development projects), heralding a new era for manufacturing, the focus is on boosting the productivity and agility of the sector - helping to provide a better, brighter future for everyone.

As you make decisions about your future, it is important to consider what you want to achieve in your career. Core skills such as decision-making, complex problem-solving and technical skills all lead naturally to a career in engineering. It also offers so much more: opportunities to progress, high earning potential, the ability to learn new digital skills and the chance to make a difference to society.

Industry-wide innovation in advanced technology - robotics, artificial intelligence, digital technologies and machine learning - are transforming businesses in every sub-sector at an accelerating pace. Manufacturing is no longer about technical skills or physical strength and dexterity. It is THE industry where cutting-edge technologies are driving the Fourth Industrial Revolution with manufacturers prioritising digital transformation focused on growth and innovation.

Couple this with higher than average UK wages and the government's Industrial Strategy, one of its key pillars being people, this makes engineering a highly appealing career path.

Read on to see how leading engineers have established their career in the manufacturing sector. Find out how our wide range of post-graduate courses could be part of your future.

Contents

CEO

SPOTLIGHT

Bryan Allcock
CEO, TRL9 Limited

Bryan Allcock is CEO of specialist consultancy TRL 9 and formerly a director of Monitor Coatings (part of the Messer Group), an international specialist coatings manufacturer.

He entered Cranfield University with a background in applied chemistry to take a PhD, sponsored by Shell, then a one-year post-doctoral placement as an employee of Cranfield. The PhD was commercial and intensive to meet the requirements and timetable of Shell, and the dissertation.

After graduating in 1994, Bryan joined Flight Refuelling Ltd, part of the Cobham Group, in surface engineering and materials where he became Head of Technical Services, covering coatings and non-destructive testing. Here he did an MBA, "which helped immensely", he says.

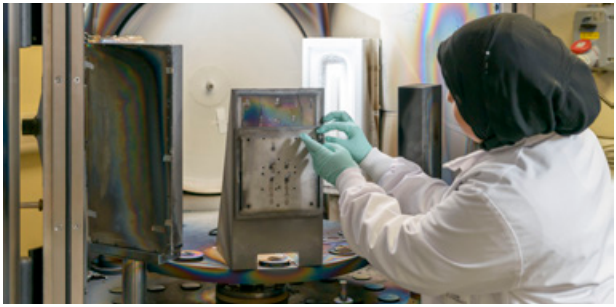
Bryan then moved to the North East to join Monitor Coatings as managing director, becoming CEO of Global Services. In 2003 he bought the company, which then had about 60 employees with a turnover of c. £4 million. Moving to new premises, Monitor Coatings focused on R&D and Bryan built up four patents and published many technical papers. The breakthrough came in perfecting thermal spray coatings and sealant technology, which was licenced globally through technology transfer agreements to the oil and gas, and steel manufacturing industries.

> "I designed the coating that the F-35s land on, John Nichols at Cranfield was a great help in solving some of the technical challenges."

During this time Monitor undertook many Innovate UK projects, which was where Bryan met the current Head of R&D at Monitor, Dr Spyros Kamnis (see page 26) "Many of these Innovate UK programmes involved Cranfield as our academic research partner," says Bryan. "Cranfield are still our academic partner in a lot of our research."

Monitor Coatings' unique offering was a combination of thermal spray technology and inorganic slurry coatings, including high temperature sealants. "This gave us differentiation with patentable materials and methods, then the ability to license these across the world," Bryan says. Here, Cranfield has a strong reputation in slurry coatings under the lead of Professor John Nichols.

Perhaps Bryan's most prestigious customer, if not by market breadth, is the Royal Navy, where his coatings protect the new QE Class aircraft carrier decks from thermal shock during the vertical landing of the F-35B variant aircraft.



Senior Technical Manager, Additive Manufacturing Machine Development

About the role

Renishaw designs and manufactures metal additive manufacturing (AM) systems, among many other technical products. Design engineering teams in Gloucestershire and Staffordshire have developed all the technology for the latest AM system, the quad-laser RenAM 500Q.

As with other Technical Manager roles, the job of Senior Technical Manager in this part of the business is a combination of team management, which demands coordinating engineering teams to get the best from their skills and abilities, with a high level of knowledge of the different technologies involved in the machine's function. Additive manufacturing technology is relatively new and fast-moving, so those working in this field have even more problem-solving and design engineering opportunities than in more mature sectors.

Ben Altwasser
Senior Technical Manager, Renishaw

The job

Ben has technical oversight of Renishaw's AM machine hardware design and line management responsibilities for some of the development team. He manages two teams of engineers, one responsible for optical systems, the other working on non-optical subsystem development. He is also the technical lead for the RenAM 500Q.

"As a Senior Technical Manager at Renishaw, you are expected to line manage engineers and be in a position of technical authority too," he says.

Additive is an exciting field to work in, being fairly new and fast-paced. It also has great future potential and therefore attracts a lot of investment. "There are plenty of career opportunities across the board offering great 'nourishment' for engineers; many areas are well-positioned for future development, research and problem solving," says Ben.

Ben does not consider AM machine design a "discipline" of engineering in its own right. "We are engineers from traditional disciplines building a new product, combining established and new technologies. In this case the end product just happens to be an AM machine. However, there are careers for AM specialists: Renishaw has Applications Engineers across the world who specialise in optimising designs for 3D printed parts."

Education

Ben has a first-class MEng in Engineering Design, a four-year sandwich degree course that led straight to a Masters qualification. It provided an industrial placement in the middle, a common first year in multidisciplinary engineering, then specialising from the second year onwards.

"Doing a four-year degree helped me because it gave me time to choose the route to specialise in," says Ben. "In a normal BEng, you have to decide what kind of engineering to go into from the outset. Having just left school with no engineering experience, I didn't know. Having four years to study also gave me valuable technical depth."

He notes that the multi-disciplinary first year has put him in a strong position for his current role, where he needs to have the knowledge to speak competently to mechanical, electronics, software and optical engineers and understand what they do.

"Additive is an exciting field to work in with great future potential"

Career progression

At Renishaw, graduates typically spend one year as a Graduate Engineer before becoming a Junior Design/ Development Engineer, which has three levels, before moving to Senior Engineer, which has two levels. After Level 2 Senior Engineer, the person can choose to go into Technical Management, or pursue a technical specialism and become a Principal Engineer. "I decided on the Technical Management route," Ben says. "I manage two small teams, but some Technical Managers manage five times that many people. There are several grades of Technical Manager. Opportunities beyond TM include a small number of company-wide strategic positions as well as side-stepping into business leadership. Most Renishaw Divisional Directors are engineers.

Progress into this career with a MSc in:

- Advanced Materials (MSc, PgDip, PgCert)
- Aerospace Materials (MSc, PgDip, PgCert)

Build chamber

"Engineering is for everyone. It is the perfect mix of technical skills and creativity, which means that if you're passionate about being able to make a difference, there is probably a role for you in engineering."

Katy Toms,
Senior Engineer, WSP.

Interview: Technical Specialist

Dr Hannah Edmonds,
Technical Specialist/Digital Engineering, The Manufacturing Technology Centre

Dr Hannah Edmonds has worked at the Manufacturing Technology Centre (MTC), part of the High Value Manufacturing Catapult, since 2012. She is a Technical Specialist in Digital Engineering and leads the Thermal Energy Research Accelerator (T-ERA) project for 'Factory In A Box' (FIAB) Manufacture at MTC.

Dr Edmonds also leads the MTC's Smart Manufacturing Accelerator (SMA), a service for delivering integrated manufacturing and supply chain solutions enabled by industrial digital technologies. The SMA uses the capabilities and digital tools developed within the T-ERA project at MTC to deliver impact for industrial customers.

"I'm excited about how the technology that's emerging in the area of digital can be implemented to kind of disrupt the way that traditional supply chains operate.

I want to provoke people into thinking how emerging technology can change the way that they operate, so traditional supply chains can be turned on their head by the implementation of new technologies in the area of digital".

What effect is digital having on manufacturing?

The benefits of using digital tools in manufacturing and the supply chain are, potentially, to de-risk the implementation of new technology. So, operating in a virtual environment and proving out those technologies and proving out those solutions before you make that significant capital investment and implement it in your day-to-day operations.

Is there anything that you are excited about watching develop over the next few years?

One of the things I'm passionate about is the implementation of digital to deliver impact in industry. So there's a lot of talk about emerging technologies and demonstrators - I'm really excited to see some of the technologies that we are showing today and talking about today - how they are actually going to be implemented in real world solutions.

What would you say to the new generation going into manufacturing?

For people who are considering a career in manufacturing or engineering in the future - it's really quite exciting because a lot of the new technologies - especially in the area of digital engineering – are aligned to what people like to do in their spare time. Simulation - there's a lot of skills that are analogous to game development, virtual environment etc.

Interview: Manufacturing Materials Technology Director

Andrew Schofield,
Manufacturing & Materials Strategy and Technology Director, BAE Systems

Andrew has over 38 years of experience in the aerospace industry and is currently responsible for the development, deployment and subsequent governance of all engineering processes, technology and capabilities used across a variety of military aircraft products.

He has experience of the full lifecycle of the aircraft products ranging from conceptual studies for future aircraft projects through to providing support to aircraft in operational service. Andy also sits on a number of advisory groups in the UK and represents BAE Systems on the programme boards of a number of High Value Manufacturing Catapult Technology Centres in the UK. He is member of the Institute of Materials, Minerals and Mining and a Chartered Engineer.

What are some of the challenges that manufacturing is facing at the moment?

The key challenge that I see from a manufacturing point of view is the introduction of new technology – this has been one of the main ones for us. A large company like ourselves within BAE systems, we work on all sorts of advanced technology - robotics, automation, 3D printing, advanced machining and joining but the challenge really is across the supply chain and across the whole enterprise. It's understanding how you introduce those technologies to meet the challenges that all industry has around lead time reduction and cost reduction and improving the whole enterprise.

What are the exciting career opportunities that the next generation can look forward to?

We recognised within our company that early careers are vital as we move forward. We're on the start of a new journey - certainly within BAE systems - of what is called the future combat air strategy, which is a sixth generation aircraft. And that will replace Typhoon in 2035 and then be in service about thirty years.

So what we're in a position to do is to actually explain that journey and it's a grand, fantastic career - something that I've personally been involved with throughout my career of seeing a development aircraft through to production, through to in service and seeing that generation. So attracting early careers graduates, apprentices. We're doubling out apprentice intake - really around the involvement in technology and what a fantastic journey it is. And we're spending a lot of time with schools and with universities to say, you know, this is the place to be - this is the journey to be on.

From Life Cycle Cost Engineer to Fleet Planner

About the role

Large engineering companies employ a host of job positions that require an engineering or STEM degree but in which little day-to-day engineering is needed. Planning and scheduling is one; planning of often complex delivery schedules, supplier coordination, or customer service costing and delivery.

Companies that have moved from only making and selling products to providing whole-life care of the product as a service (also known as through-life engineering services or servitisation) find planner roles critical to costing and organising the aftermarket business. Their job is to calculate how much a service package costs, factoring in many cost elements including transport, labour, maintenance and spares, down to the cent, so pricing can be calculated more accurately in that narrow band where profitability and competitive pricing meet.

SPOTLIGHT

Carlotta Rigatti
Fleet Planner, Rolls-Royce

Carlotta is now a Fleet Planner in the European Customer Regional Centre at Rolls-Royce but her first job post-graduation was as a Life Cycle Cost Engineer. She took a Masters degree at the Cranfield School of Applied Sciences & Management, after which she stayed on at Cranfield to do a research job.

The job

As a Life Cycle Cost Engineer Carlotta worked in the Engineering department on cost analysis alongside the company's TotalCare programme, which gives customers 100% engine capability. She worked in the Trent XWB team, one of the company's newer engine families. The job involved calculating the total life cycle cost of the engine over its 25-year lifespan. This involved designing cost models for component families and the whole engine, covering how many times parts need both replacement and repair, over that period.

Life Cycle Cost Engineering involves a lot of modelling, and it requires interacting with engineers and designers to understand failure mechanisms for the components. "An important aspect was the analysis of the probabilistic distributions of failure mechanisms, to understand when the components are likely to fail," Carlotta says. "We have to plan certain types of inspections to make sure we don't reach that point and that we replace or repair the components before that happens." The

models tell Rolls-Royce when an engine needs to come in for maintenance or overhaul so that another team can schedule this work. It is essential to meet the cost targets to ensure the product and its services remain profitable.

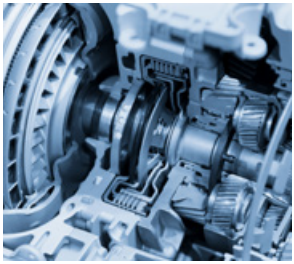
Transition from engineering to planning

As an engineer, Carlotta saw much of the product in isolation but little of the finance and service aspects. Wanting to get closer to Services & Aftermarket, she took a position as Service Business Officer, looking at the profitability of each TotalCare contract Rolls-Royce has with certain airlines. "This is a profit analysis of the aftermarket business, it does not include the sale of the engine," says Carlotta. "It covers various services, from maintenance of the engines to the provision of parts and transportation.

Now Carlotta has moved to a Fleet Planner position in the Europe Customer Regional Centre. It involves dealing with the Customers, the Overhaul bases and the Project teams. She manages the levels of spares with each customer, in the Europe region, for certain product families. It involves calculating the right balance of spare engines for each customer, to run the airline efficiently without excessive costs. "You must manage the spares level to avoid any downtime," Carlotta says. "I moved to the new role because I wanted more customer exposure and get involved with a more operational role. I was looking for new challenges in the same field to improve my understanding of other aspects of the company."

The degree

The Master degree Carlotta took was in Global Product Development and Management at the Cranfield School of Applied Sciences. The course was more relevant to her first job because it had a module on cost engineering. "There was also a great module on Lean Manufacturing and business improvement. These principles can be applied in any department in any industry sector," she adds. Post-graduation she spent one year in research at Cranfield focusing on improving Rolls-Royce Product Development System by applying Lean Product & Process Development and Set-Based Concurrent Engineering principles, which was instrumental in securing her first job.



"There was also a great module on Lean Manufacturing and business improvement. These principles can be applied in any department in any industry sector."

Progress into this career with a qualification in:

- Global Product Development and Management (MSc, PdDip, PgCert)
- Aerospace Manufacturing (MSc, PdDip, PgCert)
- Engineering and Management of Manufacturing Systems (MSc, PdDip, PgCert)

Additive Manufacturing Technology Leader

About the role

As additive manufacturing (AM) has become more prevalent for both prototyping and for making commercial parts, the need for skilled AM engineers has increased. Aerospace is a popular sector, but careers in AM engineering can be found in many other companies that need complex geometries, or where machining expensive metal alloys is considered wasteful, and where the sector thinks that additive is a potential replacement for a traditional process (subtractive).
Like all engineering jobs in manufacturing, a graduate or post-grad would typically join a company as an "engineer", work through a grade of competence and then specialise in AM, rather than studying additive manufacture engineering at university.

The Lead Engineer for additive manufacturing has responsibility for proving the material and process for making a specific part is right for the physical demands, and within the standards classification, for that part in that application. When an engineering programme suggests a part can be made additively, the AM engineer's job is to select the correct process and materials and to assess if the part can be made geometrically, and most importantly, can the AM part be qualified.

SPOTLIGHT

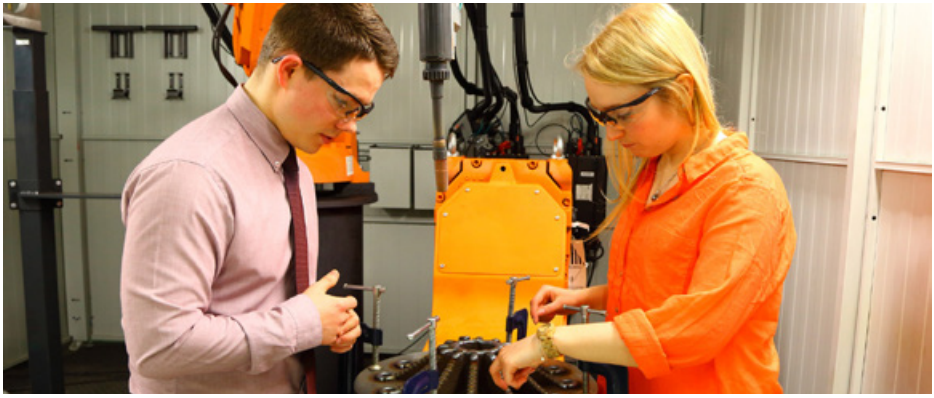
Chris Dent, Head of Research and Technology, Lockheed Martin

There are three broad applications of additive manufacturing (AM):

1. Attempting to make the same part as you made before but with AM.
2. Adapting the design to make it easier or better with an AM process.
3. A clean sheet design – make the part from scratch taking full advantage of the power of additive manufacturing. Part of the AM engineer's job is to trade-off which of these is the best way for the part in question.

Lockheed Martin's research team has several manufacturing engineers (some of whom will have masters' degrees and post graduate qualifications) working in additive manufacturing (AM). These engineers focus primarily on investigating methods and techniques that will help to develop new processes for AM.

AM engineers need strong investigative, design and manufacturing process skills to ensure the part can be



manufactured to the required specification.

"It's not just a case of putting the CAD design into the machine and pressing go."

"There is a lot of materials science and core research in this field still to be done, in both academia and industry", said Chris Dent, Head of Research and Technology at Lockheed Martin UK.

"AM engineers at Lockheed Martin work closely with the Materials Science group.

"As an AM engineer you must have the skills to develop and mature the technology and processes, as well as being able to understand the underpinning science", added Chris.

Qualifying processes and the parts for type approval are highly important in additive. "If we want to make a spacecraft part using AM then we have to justify to the relevant authorities that the part will be safe, it is made of the right materials, and it meets all the applicable standards," said Chris.

"AM today is at an exciting point. The technology is moving from prototyping into actual manufacturing."

"Many of the standards that are desperately needed for AM are still being developed and approved, and we see ourselves playing a key role in helping to accelerate the process."

Your knowledge (or) the job

A masters engineering degree alone does not fast-track a candidate to a good AM engineering job. "[For this AM team] we would expect the candidate to understand the different AM technologies, such as powder bed and wire arc, the physics of the different processes for producing a part", says Chris.

"At the entry level we would expect them to be supervised by someone more experienced, to coach them, and to supervise their work, but we would want them to quickly become competent at this work themselves."

Most of an AM engineer's time is spent investigating designs for different parts, working in a team to devise and test the chosen manufacturing process, assess the results, and decide whether the end part can be taken to production. Knowledge of metrology and non-destructive testing is very important, as this technology is still developing for the specific needs of AM.

Progress into this career with a qualification in:

- Welding Engineering (MSc, PgDip, PgCert)
- Metal Additive Manufacturing (MSc, PgDip, PgCert)

Cyber Security Consultant

About the role

Cyber security engineering and consultancy is a growing profession. Today, if a large industrial company does not employ a full-time cyber security engineer or analyst it will either outsource the role/s, or it will probably have underestimated the threat of cyber attacks to that company, whether attacks to "information technology" such as personal data or "operational technology" like factory equipment and assets, or both.

A cyber security engineer could potentially need competence in several different technical and managerial skills, depending on the role. Technical skills are needed for security design architecture, penetration testing, programming and forensics. Cyber engineers are also employed in governance roles, where they are required to understand frequently updating regulations and government specified information, to perform business risk assessments and evaluate and advise companies on their risk exposure. Reaching CISO – Chief Information Security Officer – level and even joining company boards are realistic advanced career positions.

SPOTLIGHT

Dr Mike Westmacott
Cyber Security Consultant, Thales

Mike Westmacott is a Cyber Security Consultant and Technical Team Lead for cyber security at global engineering, aerospace and defence company Thales. He has responsibility for a small team working in several cyber security areas, from technical aspects of cyber detection and protection, to understanding government specified information assurance, cyber design architecture and penetration testing.

This specific job has great diversity. One aspect is to support bids for large engineering projects with a cyber security requirement, providing plans for how Thales would solve the problem as part of the bid. Such project tenders might be to other divisions of the same company, for example in the case of an internal bid to Thales Middle East to develop a complete cyber security programme of work for Dubai Rail Systems, or for an external bid working to solve cyber security challenges for other large organisations.

The course

Mike did a computer science degree in 2003 at the University of Southampton, which gave direct access to a PhD in the field of "Search Engines for Images".

Researching the PhD helped Mike in the rigour of the research process more than the specific subject of the thesis. "Writing academic papers, presenting your discoveries to others, and learning how to sell your knowledge to other people, to get them interested in it – that is very valuable for large engineering projects especially when they exhibit certain cyber security risks," he says. In project bids the job is to explain why the [cyber] problem has to be dealt with in a specific way." Masters courses, such as MEng and MSc, in cyber engineering will be very useful, he says, as there is a lack of qualified cyber security personnel in the UK and globally, and a masters will help distinguish the candidate.

Career progression

Students considering a career in cyber should ask where their skills best fit in this expanding occupation. "Are you more of a technical person, or more interested in working in governance, management, understanding risk and working with senior

executives? Or in between these, because there will be a position for you if you have the right aptitudes," he adds.

There are several cyber security career pathways across industry.

With some experience, one career path could be core cyber security research. Big organisations like Thales have large R&D budgets and are likely to offer research roles focused on their business areas that could concentrate on enhanced protection or new product development.

A technical person in cyber security can achieve a high level of responsibility and still remain technical, perhaps more than in other engineering careers. And the discipline will soon become better recognised at the very highest levels. "Board level CISOs are not common yet but it will become increasingly common, driven by regulatory requirements and risk."

Cranfield investing in the future of Cyber Secure Engineering

Cranfield will be developing innovative solutions to industrial challenges by working with external funders and across disciplines. This could include protecting manufacturing systems from cyber-attacks, engineering the systems for security by default, improving incident response and disaster recovery in complex engineering systems, and assessing the cost of cyber-security solutions for manufacturing systems.

Newly appointed Paul Theron, Atkins-Cranfield Professor of Cyber-Secure Engineering Systems and Processes, has extensive background in cyber systems, risks and governance which will help to develop Cranfield's way of thinking in this key area of manufacturing and engineering in general.

Cranfield University is focused on the advancement of manufacturing innovation. Working with industry partners, its expertise in design, technology and management along with research into materials sciences, all with a focus on manufacturing, enables the University to provide postgraduate education, training and research.

> "You have to think like a hacker, the answers are not often in a textbook and you have to come up with your own solutions. You need a very inquisitive mind."
>
> **Mike Westmacott,** Thales

Progress into this career with a qualification in:

- Cyber Secure Manufacturing (MSc, PgDip, PgCert)

International Manufacturing Project Lead

About the role

As the name suggests, this is an international role entirely responsible for a product or product family and the coordinated assets that manufacture that product, across multiple sites, often cross-border. The International Manufacturing Project Lead will have already reached a senior engineering grade with responsibility for a product family, to be appointed with the job of coordinating different sites in the production of that product or assembly. Overseas placements, often for more than a year, are typical in this job and absorbing and managing cultural differences at multiple locations is required.

Successful International Project Leads must be able to expertly juggle the requirements of the customer with the constraints of the manufacturing sites under his/her umbrella, and have responsibility for design standards and budgets.

SPOTLIGHT

Rob Emms,
Principal Engineer for Fuel Systems, F-35, BAE Systems

The job

Rob previously worked in the International Industrial Participation team for the F-35 Joint Strike Fighter, the world's most advanced fighter aircraft. In this role he established six production lines globally, was the responsible engineer for their operation, transferring engineering capability to them and supporting this as they came online. Rob helped set up two such facilities in Canada, three in Australia and one in Denmark and the US.

He was seconded to Vancouver for two years, standing up a production facility to manufacture outboard wings for the carrier version of F-35, which included transfer of the design authority from Lockheed Martin to BAE Systems and working with a Canadian company to set up the new production capability in Canada. He returned to Britain in 2012 to lead the rest of the UK team until July 2018.

The course

Rob took a part-time MSc in Aircraft Engineering at Cranfield when he returned to the UK in 2012. Having always been involved in airframe design, he wanted the masters to have a broader knowledge of the aircraft than in his previous job.

"The teamwork and leadership was a crucial component, having seen a lot of those leadership pieces in other roles through my career. I knew it

The masters course equipped Rob with new skills for the final stage of his International Leader role and his current job as Principal Engineer for Fuel Systems on F-35.

would benefit me," Rob says. He identifies the one-year, group project to design, build and fly an all-electric aircraft as a course highlight. A group of international students based at different companies worked together to deliver the project. "You have to select an area of technical interest, to deliver on time, which also has a leadership element. It is part-time and we had only four to five weeks together each year, which required working remotely, using technology like video conferencing to stay connected." Rob shared the course with students from India, Romania and Sri Lanka.

Ultimately the aircraft did not fly, as the person leading the wing design didn't progress to the required stage. This taught the students that in business you can only progress as fast as the slowest person or he who needs the most support.

The aircraft engineering course was customisable, allowing the student to select the areas they wanted to develop most, such as elements of vehicle systems, crash investigation, certification, and aircraft performance. Rob's class used Cranfield's fly-in test lab, a Jetstream aircraft equipped with 12 work stations, allowing students to monitor real-time readings while in flight. Morning lectures and afternoons in the in-flight lab were a perk of the course!

Career progression

The masters course equipped Rob with new skills for the final stage of his International Leader role and his current job as Principal Engineer for Fuel Systems on F-35.

"It has demonstrated to the Chief Engineers here, the value of this education level. In career discussions they have recognised you can achieve much more than what you have done to date, and gives them the confidence to support your career progression."

While doing the MSc Rob collected two awards, the Boeing award for Best Student for that year and the BAE Systems award for Best Research Project. He says both have fed back into BAE Systems for future career progression.

Progress into this career with a qualification in:

- Global Product Development and Management (MSc, PgDip, PgCert)

Manufacturing Engineer

About the role

Manufacturing Engineer is one of the most numerous careers in manufacturing for a qualified engineer, for both graduates and post-graduates. Indeed.co.uk, the job listings aggregator, says there were 504 vacancies with the title "manufacturing engineer" across the UK over seven days to September 19. All the big automotive and aerospace OEMs and tier one companies employ manufacturing engineers and such positions are in demand through the supply chain at companies making components for the end OEM customer.

A manufacturing engineer will normally have responsibility for specific elements of a product or product family, which would almost certainly involve quality and inspection, testing, rate (productivity) and the other core requirements that the customer demands. He/she will also need softer skills including the ability to be a productive part of a team, but people management is not a high requisite – yet. Knowledge of continuous improvement and other Lean manufacturing principles is useful. Increasingly a Manufacturing Engineer will need to understand aspects of digital manufacturing including digital twins, data capture using sensors, informatics, the protocols for exchanging data between machines and a Manufacturing Execution System and other skills.

SPOTLIGHT

Anxo Rodriguez Manufacturing Engineer, Rolls-Royce

The path

After graduating from the University of Vigo in 2015 following a five year BSc and MEng course, including a one year thesis at Cork Institute of Technology, Anxo was awarded a EUROPA Scholarship (one of just five) at Cranfield to enrol on the Aerospace Manufacturing MSc in 2016. "This was my number one priority as I always had a preference for manufacturing and Cranfield was the very top university in the UK for aerospace manufacturing" he says.

The job

Anxo is currently a Manufacturing Engineer for the Assembly & Test business at Rolls-Royce for the New Product Introduction department. New Product Introduction focuses on the development of a product to meet quality conformance and production rate targets so that it reaches maturity for "productionisation".

He has worked with the Trent XWB 97K and Trent 7000 engines. His main task is to demonstrate that the product meets the quality and

rate criteria required by the customer for different parts of the engine.

The manufacturing engineering team within the Assembly and Test function is around 20 people, where he reports directly to operations and programme management.

Before starting here, I covered different projects across the product lifecycle from Capability Acquisition (involving specifying new technology, factory design and layout and capital equipment) and Continuous Improvement, the identification and development of improvement opportunities for the current product portfolio of the company such as reduction in task, time or cost."

Value of the Masters course

Anxo was based at Airbus for four months during his individual thesis and continued working there for one more year before moving to Rolls-Royce.

"The MSc helped enormously in developing my soft skills during numerous projects with top industrial companies including Alfa Laval and Airbus, which included direct reporting to them," he says.

He cites the numerous presentations to academic experts as very useful. "It deepened my technical understanding in areas where I was not as strong such as Operations Management," he says. "The MSc had a crucial role in providing me with key experiences working with top industrial companies in the manufacturing world and helped me improve my skillset to become a better engineer."

Career progression

Anxo intends to enter into the Leadership Programme that Rolls-Royce offers in early 2019. His medium term career aspiration is to become a Manufacturing Engineering Manager within the Civil Aerospace business at Rolls-Royce.

"I would definitely recommend Rolls-Royce for any engineer that is passionate about what the company does, where you have very powerful support to grow as a professional and as an individual and diversity and inclusion are paramount."

"The MSc had a crucial role in providing me with key experiences working with top industrial companies in the manufacturing world and helped me improve my skillset to become a better engineer."

Anxo Rodrigues, Rolls-Royce

Progress into this career with a qualification in:

- Aerospace Manufacturing (MSc, PgDip, PgCert)

Interview: Chief Executive

Professor Juergen Maier,
Chief Executive,
Siemens plc

Juergen Maier was appointed Chief Executive on 1 July 2014. He has been a member of the Siemens UK Executive Board since 2008 and has held senior roles within Siemens in the UK and Germany. This included Managing Director of Industrial activities for the UK and Manufacturing Director of the award-winning Drives factory in Congleton.

Juergen joined Siemens in 1986 with a BSc in production engineering from Nottingham Trent University, on a Siemens-sponsored graduate programme. He was made an honorary professor of Engineering at the University of Manchester in March 2014 and became a Fellow of the Royal Academy of Engineering in September 2017. Juergen has also received honorary doctorates for his services to UK Science and Engineering from the Universities of Lincoln, Nottingham Trent and Salford Manchester.

"I have a passion for the future of manufacturing. I think we need to do a much better job of creating the fourth industrial revolution than we did of the third and make sure we support the industry on creating that industrial revolution".

"One of the key things that we need much more of as part of creating a stronger fourth industrial revolution is leadership. It is the manufacturing community being really proud of the achievements we have - talking up our industry, making our industry so much more exciting- that it's digital, it's about data, it really is an industrial revolution. This is not some dark, dingy, boring type of job. We want to enthuse ourselves and we want to enthuse the future generation".

What would you say to encourage the next generation in manufacturing?

For young people setting out on a career today, I always say that engineering is incredibly interesting. The making of things, the creating of things is interesting. There is a new world of making things, it's very digital and data-driven.

And then there is other good news which is that the salaries are pretty good in our sector.

It's definitely rewarding work, when I talk to the apprentices we have in Siemens. So I think that this is a great career opportunity for anybody who's thinking about studying and their direction in life.

What are some challenges in the industry at the moment?

I think one of the key challenges we're all facing in manufacturing is how do we up-skill ourselves as the leaders in manufacturing companies, as the management, as the people working in manufacturing. How do we stay relevant in all of the digital technologies such as additive manufacturing, robotics, artificial intelligence? And that's the real challenge of how to up-skill ourselves and all of our people and we need to work much harder at that.

Interview: Director of Manufacturing

Professor Mark Jolly,
Director of Manufacturing,
Cranfield University

What makes manufacturing such a great industry and exciting for future generations?

One of the problems with manufacturing is that there is still this image of it being like Dante's Inferno. In the early 1700s people used to visit the Severn Valley to go and look at the light that was generated by the blast furnaces in the industrial revolution. There are many, many examples of painters who used to go and paint in the Severn Valley and you've got this amazing glow of manufacturing, the red hot heat of manufacturing. I think the white heat of manufacturing was a Harold Wilson expression in the 1960s.

Manufacturing, nowadays, is not all red sparks and heat. It's far more complex than that, it's an intellectual challenge. It's very much more related to computer games than it is related to hot iron and blast furnaces. They still exist but not so much in the UK.

> "We are thought leaders in the manufacturing space."

UK Manufacturing and high-value manufacturing contains as much problem-solving as any other profession could be. So what we have to do is to try to get that message across to our current generation's parents as well as the next generation, who think that manufacturing is back in the dark ages and we have to change that perspective.

Development Engineer

About the role

At a small but growing engineering company with international expansion ambitions, the multi-tasking development engineer can have a lot of responsibility making innovative products and assisting in business expansion. Probably much more than as a team member in a very large firm. Here the development engineer will cover a very wide portfolio of tasks in many areas of the business.

Axon Automotive designs and manufactures light and strong all-carbon fibre structure vehicles. Rushabh Shah is responsible for the R&D and production technology for manufacturing the car chassis, the whole body crash structure. His background is in polymer materials research and manufacturing.

SPOTLIGHT

Rushabh Shah
Development Engineer, Axon Automotive

The job

Rushabh is responsible for setting up the new R&D lab including specifying all the equipment. This requires knowledge of R&D trends in the wider automotive industry and formulating a 10-year plan for future technology that Axon will need. He has supervised building a pilot line for production in the lab. "It has to mimic what we do in the actual production line," says Rushabh. "After the R&D phase we continue to re-specify and refine what we need in the prototype line."

The course

His course was the Manufacturing Technology and Management MSc at Cranfield, during which he supported Axon Automotive, not on site but by exchanging and processing their data to help define their processing methodologies. He says the master's thesis helped him by providing proper planning and execution of a project., reflecting a real business. "You get that hands-on experience of what can go wrong, real budgets and why you are doing what you are doing," he says. "Showing this to the [Axon] management, talking to real customers, working on a project consortium, creating a supply chain. This is all helpful for the development engineer's position."

Rushabh wanted to focus on management, having already studies and been employed in engineering for the previous eight years. The course had several such

modules, including operations management, Innovation management and Product portfolio management. "These modules testes your people and organisational skills, which was useful for my current job," he says, where at Axon he is bringing new people in, delegating tasks and getting everything streamlined on the factory floor. "On the course you do business pitches, learn about changing markets, and there is simulation of real-life scenarios to get budgets correct," Rushabh says. "In Product Portfolio management, you have to choose which business you'll invest in to get the company on the right track, which helps see the bigger scenario. Sometimes the small details you look at as an engineer are not relevant to the strategy of the company," he adds.

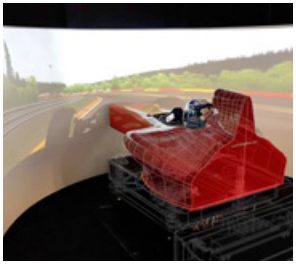
Advice to postgraduate students

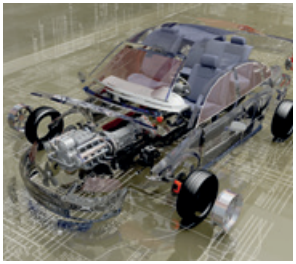
Rushabh advises people to work in the industry where they plan to be before they get their masters, where he had some year in industry placements before joining the course. "You have the experience of working, so you are not just a theoretical engineer. The course only becomes relevant when you ask the right questions, which work experience enables you to do."

"On the course you do business pitches, learn about changing markets, and there is simulation of real-life scenarios to get budgets correct"

The next step

Product and business Development Manager is the next logical position. Beyond this, being responsible for setting up a new facility abroad, perhaps in China, is plausible and becoming the plant manager or CEO there.





"You need to get that hands-on experience, further education only becomes relevant when you ask the right questions, which work experience enables you to do."

Rushabh Shah, Axon Automotive

Progress into this career with a qualification in:

- Global Product Development and Management (MSc, PgDip, PgCert)
- Manufacturing Technology and Management (MSc, PgDip, PgCert)

R&D Manager In Materials Engineering

About the role

As the name suggests, an engineer with responsibility in research and development for a company that manufactures special materials must have a strong scientific background and must live and breathe core research. He/she must understand the science, they will set up laboratories, commission the correct equipment including testing equipment, know how to operate it all, learn about new developments globally in the materials he/she works in. The person must also know how to translate the lab research work into production and is likely to be responsible for facilities at multiple sites, nationally or internationally.

SPOTLIGHT

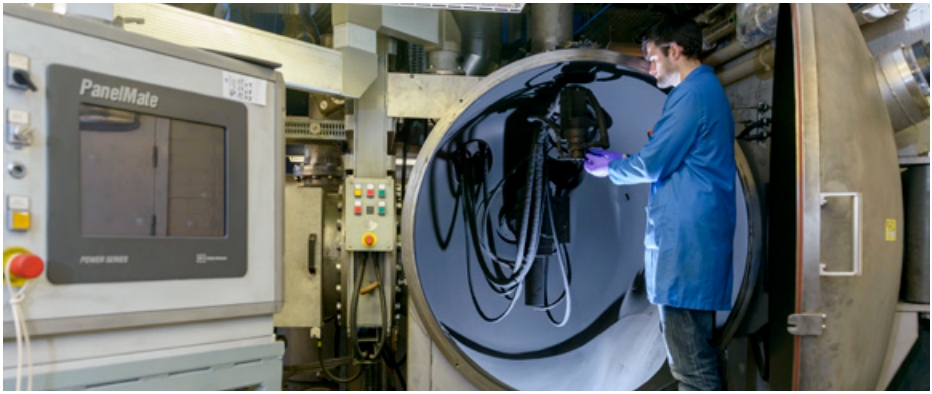
Spyros Kamnis
R&D Manager, Monitor Coatings

Monitor Coatings is part of Castolin Eutectic, a division of the Messer Group, the third largest specialised surface material engineering company in the world. Spyros Kamnis runs R&D at Monitor, where his main duty is to ensure the company's global service centres meet their objectives for developing new products and technologies, and to improve the performance of existing products. He must ensure that the company's products compete with and surpass the competition.

Depending on the functional requirements of the end product, the company develops advanced metallic/ceramic and composite coatings.

The market is big: special coatings are applied to almost every metallic product in the aerospace, automotive and oil & gas markets. In oil & gas, expensive drilling equipment suffers corrosion and wear from operating in a harsh environment. "Our coatings extend their life so they stay in service longer, adding a lot of value to the components, and their companies," says Spyros.

Monitor Coatings was one of the first UK companies to receive the international aerospace NADCAP accreditation, which allowed it to apply its proprietary technology on critical parts in jet engines.



Education creates the process

Spyros has a Masters degree in thermal power and a PhD in material science from Aston University. His industry-led PhD centred on the development of a thermal spray process – a high velocity oxyfuel thermal spray – during which he developed the concept of the equipment needed to apply these metallic materials onto the surface of equipment. Spyros then presented the work to the company, filed a patent and together with Monitor developed the technology, while working as a University lecturer. When the technology reached a higher technology readiness level "TRL", Monitor's R&D department brought the process to the market. Bryan Allcock, managing director of Monitor, who is a Cranfield University alumnus, recognised the potential of the technology and commercialised it with Spyros' help.

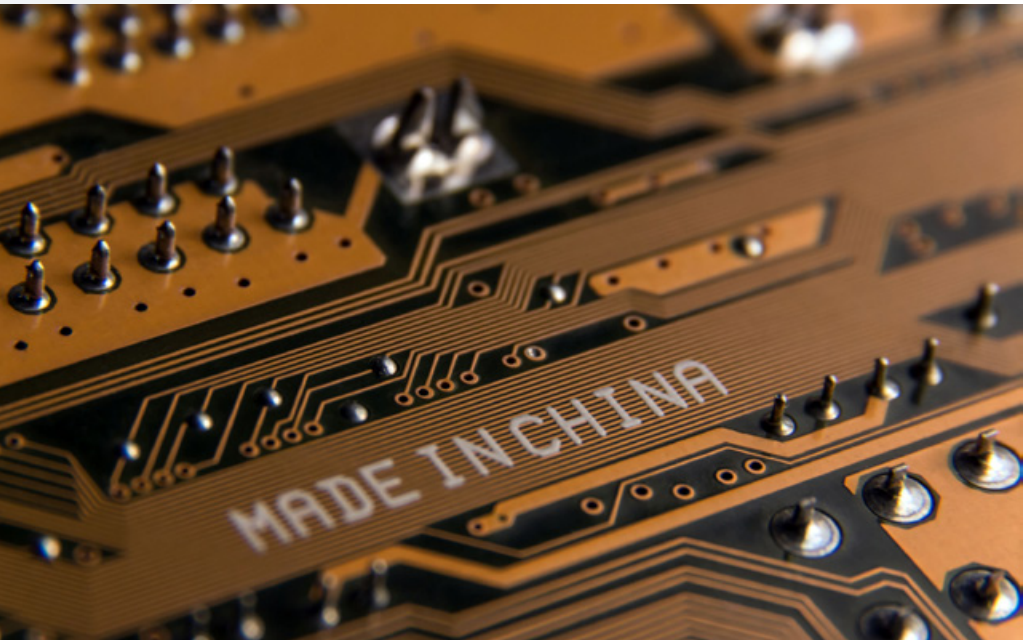
"Recession proof" thermal spray technology

The surface engineering and advanced coatings market affects hundreds of thousands of industrial parts and has a huge value. "In aerospace, there will always be a need for specialists here, to serve this key sector for the UK," says Spyros. In the aerospace, oil and gas sectors, thermal spray and surface modification techniques are used to refurbish parts that have been in service a long time. During the 2008/9 recession and in the oil and gas downturn, many companies came to Monitor to refurbish their equipment rather than purchase new kit.

"The market is big: special coatings are applied to almost every metallic product in the aerospace, automotive and oil and gas markets."

Progress into this career with a qualification in:

- Global Product Development and Management (MSc, PgDip, PgCert)
- Advanced Materials (MSc, PgDip, PgCert)
- Manufacturing Technology and Management (MSc, PgDip, PgCert)



Manufacturing in the Chinese market

Made in China 2025 has set Chinese manufacturing on a path from being the world's "factory", moving to producing higher value products and services, alongside increasing the domestic content of core materials. Recognising both external and internal issues China is moving the country's manufacturing higher up the value chain and seeing great opportunity to upgrade, innovate and transform.

China is now the largest manufacturer in the world also being the world's largest automobile producer and number one manufacturer of electric vehicles. Chinese companies like Comac are developing commercial aircraft as alternatives to Boeing and Airbus and require skilled researchers and engineers to compete on the global stage.

With government policies such as tax and fee reductions helping build business confidence internally, the Chinese economy - and its manufacturing industry - continues to grow and build resilience regardless of wider cross border issues - making engineering a highly appealing career path.

Manufacturing in India

India's manufacturing industry has emerged as one of the highest growth sectors in the country in recent years. Supported by the Prime Minister's 'Make in India' programme, the vision is to place India on the world map as a manufacturing hub and give global recognition to the Indian economy. This alone makes engineering a highly appealing career path.

With global giants such as GE, Siemens, HTC, Toshiba, and Boeing either having set up or are in process of setting up manufacturing plants across the country, India is on the path to becoming a hub for high-tech manufacturing. By 2025, the sector has the potential to reach US$ 1 trillion. In fact by the end of 2020, India is expected to become the fifth largest manufacturing country in the world.*

* Global Manufacturing Competitiveness Index published by Deloitte.

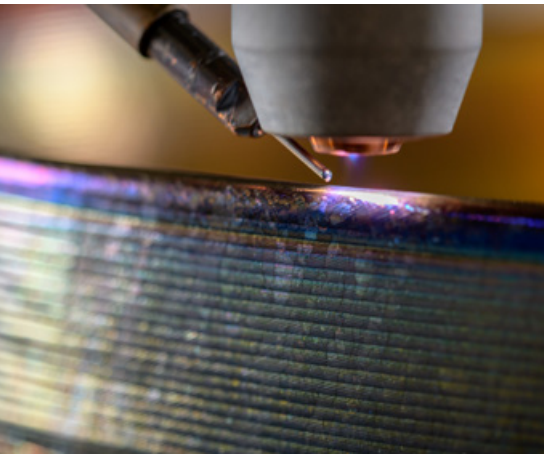
Interview: Dean

Professor Ravi Prakash,
Dean, Faculty of Engineering and Technology, Amity University Uttar Pradesh, India

Professor Ravi Prakash has more than 45 years of teaching, research and administrative experience. Here is what he has to say about digital manufacturing, the industry and the value of a master's degree.

What are some of the benefits that digital is having on manufacturing?

These days practically all manufacturing is using digital technology. Additive Manufacturing or so called 3-D Printing is a big help for manufacturing simple (as well as intricate) parts, and it has eliminated the wastage of materials as is seen with subtractive machining or so called conventional machining.



Development of cades for CNC machining or additive machining is required for doing ahead with digital manufacturing but thereafter it becomes fully automatic.

New developments take place on a day to day basis, giving us the opportunity to develop new materials, new products and new designs.

> "A master's degree is essential to having a good career."

What is the value of a master's degree?

It prepares you for higher education as well as for jobs requiring a greater depth of knowledge and analytical skills. In my case, my master's degree was an enabler for my research career at Cranfield with exposure to Royal Aircraft Establishment, Farnborough and making a dent in the development of non-destructive testing techniques for carbon-fibre reinforced plastic composites.

Is there anything you would say to the next generation thinking of a career in manufacturing?

Manufacturing professionals are always in demand by industry and their OEMs. It's an exciting industry to work in, and having a passion for your profession ensures you will enjoy it to the maximum.

Interview: Managing Director

Mahendra Patel,
Chairman and Managing Director, Mamata Group

Mahendra is the founder of the Mamata Group based in Ahmedabad, India and is the Chairman and Managing Director of its flagship company, Mamata Machinery Private Ltd. Mamata is the pioneer in manufacturing bag making machines with indigenous developed technology and other packaging machinery. It exports more than 60% of its production worldwide. The Group is made up of several companies including Mamata Energy, producing renewable energy equipment.

Mahendra obtained his MSc from Cranfield University in Industrial Engineering and Administration in 1973.

What opportunities are there for graduates in the Indian manufacturing sector?

The Indian manufacturing industry has been very fortunate in some respects in that we have been able to leapfrog some of the emerging technologies.

For example, my company do a lot of robotic automation for manufacturing and we have a complete bank of fully automated machines that is looked after by one man (one operator) because it's more efficient and gives a more precise quality etc.

So, we've been able to leapfrog that stage of too many machines with a lot of man power. The next stage is 3D manufacturing and additive manufacturing. We are adapting very quickly in response, because India is a large market and diverse which means there are a lot of things which have to be produced in small volumes.

What works for one market, may not work for another market.

If you could start your studies again what subjects would you choose and why?

I would always choose manufacturing, no question, but I would choose some of the management subjects which cover finance also. Ultimately, everything is expressed and valued in money – it's all about your profit margins. I'm now running many companies and my Indian business is worth around $200m-300m.

"Manufacturing is a true way to create wealth."

What are your 'top tips' to somebody considering studying an MSc?

The main thing is to choose your subject very well. You should choose a subject that you really like and would love to have a career in, a subject you enjoy not because your peers are doing it. Do it because you love to do it, don't be a follower!

Cranfield really provides an element where you can fully concentrate on your studies with fortunately, very few distractions here including no undergraduates.

Senior Manufacturing Engineer

About the role

As the name suggests, Senior Manufacturing Engineer is typically the next career step after serving several years as a Manufacturing Engineer in a large company, where the candidate has demonstrated the deep understanding and competence to do this more responsible job. Rigour, accuracy, responsibility, and people management are core skills. It is crucial to have a good understanding of the design standard of the product you are responsible for, while trying to deploy new technology and keep within budgets and delivery schedules.

A senior manufacturing engineer can manage large teams, depending on the size of the division and the company.

All complex assemblies have a design standard that dictates how the component or assembly is manufactured. The senior manufacturing engineer's job is about how you reach this objective most efficiently and most affordably, using appropriate technology and innovation to reach that design standard.

A senior manufacturing engineer will:

1. Bring good and appropriate technology into the process
2. Ensure the part (he/she is responsible for) is built to that rigid design standard
3. Oversee that this is done as efficiently as possible at the lowest cost while achieving the highest standards of quality.

SPOTLIGHT

Dr Paul Needham CEng FIET
Head of Engineering and Global Engineering Fellow, BAE Systems

The path

Paul Needham started his career as an apprentice, receiving an HNC and HND then took a Bachelor degree. He was then awarded the status Chartered Engineer by the Engineering Council. Later he undertook a PhD in Design for Manufacture over five years of part-time study. He became a Fellow of the Institute of Engineering and Technology and BAE Systems Global Engineering Fellow, and is now a visiting Professor at the University of Huddersfield, where he chairs the Industrial Advisory Board. Paul is Head of Engineering for the F-35 Lightning II Programme at BAE Systems.

The job

This responsible job is largely shaped by the design standard of products, and the constraints of time, budget, technology and manpower.

"There are lots of challenges in manufacturing," says Paul. "You need to have a good understanding of the manufacturing processes

and understand the risks associated with them whilst ensuring you deliver the product to the design standard at the right cost and the high quality standards expected from our highly complex products," adding that when ensuring product safety, the design standard is a line that you don't cross - as this is something the senior manufacturing engineer is looking out for every day.

Knowledge of emerging manufacturing technologies that can exceed the customer's quality criteria, reduce potential risks and keep to the design standard is important. A new technology may suit the job on some metrics but alter the product's physical specification; a senior manufacturing engineer has to have a good understanding of how this technology impacts the product.

"In an engineering career [a masters] gives you that extra springboard, especially if you can study part-time"

Value of postgraduate qualifications

"In an engineering career [a masters] gives you that extra springboard, especially if you can study part-time," says Needham. "It broadens your knowledge of engineering and brings in engineering leadership. The more senior you get in the organisation the more you need to rely on leadership, and less on the detailed engineering elements."

He adds that postgraduate education gives engineers a chance to collaborate with bright people in another industry; in their case, with automotive and even food industry engineers. "Those who have come off the Masters course say that kind of cross-industry collaboration is really valuable for germinating new ideas."

Career progression

At some companies the Senior Manufacturing Engineer might be the most senior engineering role. At the big blue chip companies of £1 billion revenues or more, typically a SME could move on to Head of Engineering for a department or product family, or Chief Engineer for an entire division and eventually for the company.

- All manufacturing courses at Cranfield are available full- or part-time. For a full list of Cranfield's Manufacturing courses, see back page.

Interview: Project Research Associate

Rachana Bhanushali,
National Centre for Aerospace Innovation and Research, IIT Bombay, India

Can you tell us what your job entails?

As composite materials are increasingly being used for aerospace structural members, the need for skilled materials engineers has increased. Aerospace is a popular sector in which careers in materials engineering can be found in many other industries where weight savings lead to significant cost reductions or the sector thinks that composites are a potential replacement for traditional materials (metals). A graduate or post-graduate would typically join a university as a Research Assistant or Research Associate respectively.

The Research Associate for composite materials is responsible for researching innovative materials, appropriate manufacturing methods to be used for a given application and testing the materials as per the standards. Upon successful verification, the novel material, recommended design and optimized manufacturing technology are incorporated.

What is your educational background?

I have obtained a Bachelors in Physics from the University of Mumbai. After that, I decided to pursue a master's degree from Cranfield but was unsure about the exact MSc course given the wide range of courses on offer at Cranfield. Doing a pre-masters in engineering helped me make an informed decision about the exact MSc course I wanted to pursue. Finally, I obtained an MSc in Advanced Materials from Cranfield University. During this course, I've had the opportunity to learn about different engineering materials and their behaviour. I've always been keen on learning about different materials and how they respond under different load conditions.

Can you tell us about career progression in this field?

Typically a graduate or post graduate would join a university as a research assistant or research associate respectively. They can then specialise in composite manufacturing and could then work their way up to Managerial posts. A PhD, and a post-doc could work their way up to professorship.

What would you say the value of a master's degree is?

A master's degree might allow you to jump a grade. For this it is very important for you to take advantage of the numerous opportunities available during your masters to improve your skills. Especially, focussing on presentation techniques, written reports and networking will go a long way. Being exposed to industrial practices and incorporating them in your coursework will prepare you to be 'work-ready'.

The group projects are highly regarded by the industry as it showcases your ability to work in a team and a multicultural environment. Getting an industrially-sponsored project for your individual thesis will help you recognize your strengths and area of interests.

> “I believe that materials define civilisation - it is materials that push technology through, they change the way we live”.

What are some of the benefits that digital is having on manufacturing?

A digital factory design is a far more flexible workplace. Instead of the traditional, linear approach, where machinery is built based on designers’ sketches and development cycles are siloed, digitisation makes it possible to plan and develop in tandem. That way, potential weaknesses can be identified and fixed as you go, rather than in hindsight. With the advent of sophisticated software’s which simulate manufacturing, significant cost-savings, weight reduction and time optimization have been possible. One such application is 3D printing.

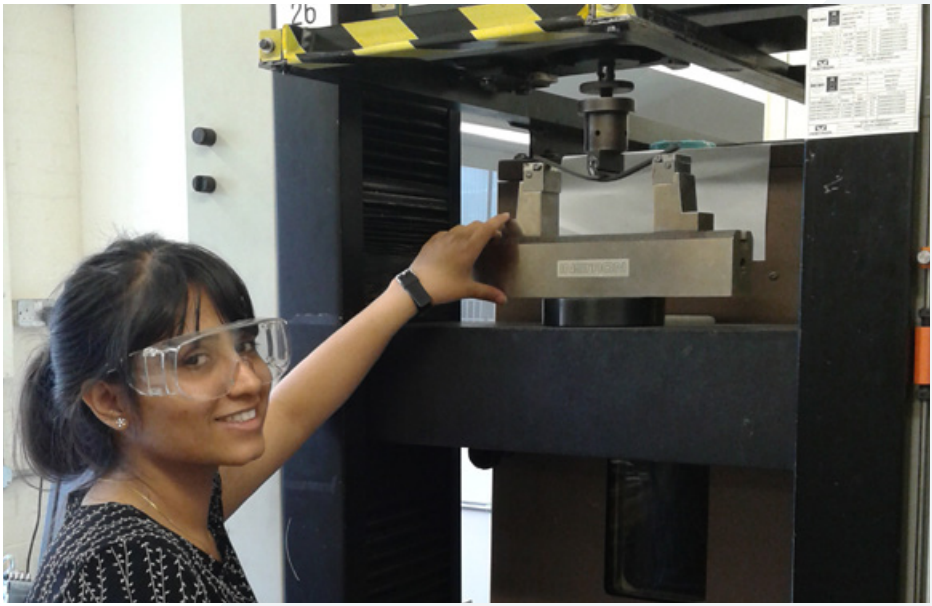
What are your next steps?

As I have a currently gained experience working in a academic area, I would like to migrate to the manufacturing department of the aerospace industry. I would like to working for a big company with inter-disciplinary departments so that I can learn more about the whole life cycle of a product. Ideally, I would like to work in a foreign country to gain more cross-cultural working experiences.

Can you give a ‘top tip’ to the new generation going into manufacturing?

My number one tip is “always help others”. It not only helps in transferring knowledge but you will also learn new things in the process.

Secondly, take initiative and ask for opportunities. After graduating, doing a graduate scheme would be a great stepping stone. This two-year rotational program gives new graduates an opportunity to experience working in different departments of a company.



Interview: Graduate Quality Engineer

Alessandra Caradonio,
CMR Surgical

Alessandra Caradonio has always had an interest in structured analysis and problem solving to define creative and fact-based solutions to complex problems.

Starting her educational path in an Industrial Engineering degree in Italy, Alessandra then had the chance to study abroad in Spain for 6 months and have her first manufacturing experience overseas. It was from this moment on that she then started to get closer to the manufacturing environment, moving to the UK to appreciate the role that manufacturing has in Industry 4.0 which differs from Italy.

CMR is a medical technology company that manufactures a robot called Versius for Minimal Access Surgery (MAS) where Alessandra is currently employed as a Graduate Quality Engineer. As a medical company, it requires a high focus on quality assurance and proper use of ISO 13485 highlights good management of the non-conformities within the manufacturing process.

The job

As a manufacturing engineer, I am analysing the non-conformance reports (NCR) to assure continuous improvement of the value-adding activities through deep data and root cause analysis. The industry I'm currently working in is complex and challenging - building up a surgical robot requires high focus and knowledge in both manufacturing and operations, but also a robust consideration of the quality since Versius is going to deal with human patients.

Career progression

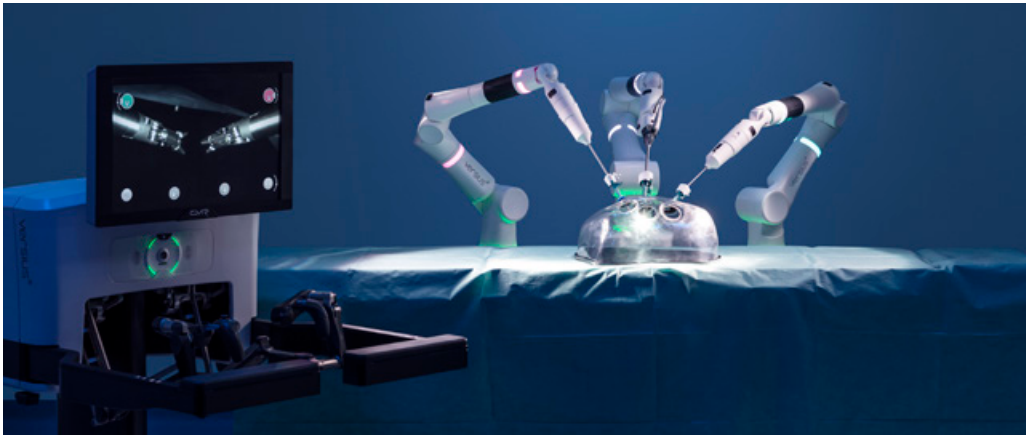
My first experience of work in the professional world was for an Italian multinational company, Enel, active in the sector of electricity. It was an interesting experience because it taught me how important it is within the industry to provide a great customer relationship experience. This role helped me to realise that manufacturing was what I would like to do as a job.

> "My master's degree enhanced my knowledge and heightened my passion for this industry."

During my journey at Cranfield University, I had the chance to work in a medical devices manufacturing company in Swindon. Thanks to that experience, I have been fascinated by medical devices in industry in terms of manufacturing and mission ever since. Therefore, I applied to CMR Surgical with the hope of learning this side of manufacturing.

Value of a master's degree

A master's degree will give you the chance to get closer to the working environment, teaching you how to face challenges within industry. The



difference between a bachelor and a degree is the level of specialisation. I decided to apply to a manufacturing master's degree because I had faith in the industrial sector and hope that I've taken a role in the next generation's future.

Benefits that digital is having on manufacturing

There are numerous benefits if we look at the correlation between digital and manufacturing. Innovation is currently at his highest developed stage and industries must take advantage of this. Productivity, efficiency and effectiveness of all manufacturing companies have been enhanced by implementing digital for example digital twins or digital factories are the driver of this brand-new industrial revolution based on digital innovation.

A noticeable and considerable benefit that is sometimes forgotten about is the way businesses and human relationships could be enhanced by implementing digital techniques. Digital will provide more efficient management of data as well as providing potential risks for companies.

An interesting fact about the sector you work in

I currently work in a highly competitive sector due to the level of innovation which requires the industry to be moving with the times.

As a surgical robotics company, we require a high level of knowledge and responsibilities since the final customer is a human patient that is going to receive surgery. The mission is to change millions of people's lives, guaranteeing the best result. The challenging and stimulating point of this sector is always assuring the top-quality level in regards to ISOs and standards.

Your next step

I believe there is always room for improvement when it comes to knowledge. My next step will be to learn as much as I can within CMR and to discover new horizons. I would like to improve my skills further and learn new ones along the way to always be up to date with the unstoppable industry evolvement and development.

Top tip to new generation going into manufacturing

I would suggest to all my future colleagues to be open to all industries because manufacturing is a state of mind. Try to learn as much as you can during a master degree because it will give you a competitive advantage that will differentiate you from others.

Be humble but ambitious, be innovative and do not be afraid of communicating your ideas. Be a great team worker because manufacturing is working together, and my last tip - be the change you want to see to be a manufacturing future maker!

The recruitment specialist

The UK manufacturing sector (9th largest in the world) is experiencing its longest period of sustained employment growth for four decades exemplified by the fact that in the past five years till March 2018, 145,000 manufacturing jobs were added to the UK economy. There really is no better time to join this dynamic and buoyant sector to further your career!

Despite all the uncertainly created by Brexit and its ongoing negotiations, in 2018 we have posted news reports detailing over 100 new factory openings and a further 50 factory expansions. This is another indicator of healthy growth in the sector. Personally, I haven't observed such a strong run on new factory construction before.

The demand for graduates, apprentices and experienced hires in the sector is extraordinary. We call it a 'candidate driven' market as candidates with the right skills invariably have a wide-choice of companies to select from and this trend will in my opinion continue for many years to come.

Manufacturing is often portrayed in the mainstream media as very traditional and in decline but this is far from the truth. The rate of technological advancement in the sector is truly extraordinary, with the adoption of leading-edge technologies such as additive manufacturing, artificial intelligence, digitisation and virtual reality at the very heart of what is commonly referred to as Industry 4.0 or the Fourth Industrial Revolution.

To make the most of these new technologies manufacturing companies need graduates with up to date knowledge and the ability to apply it in a rapidly changing dynamic environment.

It is also true that manufacturing has traditionally been regarded as male-dominated but many organisations have done great work in recent years encouraging diversity. Social media campaigns such as #9PercentIsNotEnough have raised the profile of the sector, to meet the unprecedented demand for talent. Manufacturing (as with other sectors) needs to be, and is, an industry for all.

To summarise, there really is a role and a career for everyone within the UK's buoyant manufacturing sector. New technologies, applications, factory developments and opportunities are reported every day and shows absolutely no sign of abating. Rapid career progression is a real possibility as graduates joining the industry with the right skills and knowledge of the latest techniques are in high demand.

What's stopping you?

Stuart Whitehead has 25-years' experience of working with and chronicling the UK's manufacturing sector. In recent years, he has established the popular Twitter account @Jefferson_MFG and works with specialist recruitment consultancy Millbank Holdings.

Supporting your career development

The Career Development Service is an important branch of the Student Experience unit. Our team has significant real-world experience in the areas of coaching, recruitment, human resources and business development. We offer skills development which will enable you to find meaningful employment utilising your Cranfield qualification.

We support all MSc, MBA and PhD students with their career journey at Cranfield and beyond.

Our coaching activities

- One to one appointments with our in-house career advisors.
- Career direction and transition management coaching.
- CV writing, cover letter development and application form advice.
- Psychometrics, assessment centre and interview skills training.
- Pop-up careers stands, desk-side workshops, assisted company visits.
- CV yearbook generation, group design project preparation.
- Support in negotiating salary and benefits packages.
- Advice for entrepreneurs starting their own business.
- Introducing international students to our visas and immigration team.
- Signposting international students to advice on working/living in the UK and abroad.

Our employer engagement activities

- Build relationships with industry to generate employment opportunities.
- Manage and vet vacancies on our online career management portal, Symplicity.
- Advertise events and jobs through social media.
- Weekly employer presentation evenings.
- Spring and autumn Careers Fairs.
- Industry networking events.
- Headquarter and site visits.
- Employer speed-dating sessions.
- External industry expert workshops.
- Guest spots on pop-up careers stand.

Our marketing activities

- Digital and print resources including learning packs, factsheets, tutorials and videos.
- Event videography, employer/student. interviews and photography.
- Social media channel management, engaging the student audience.
- Promote relevant employment opportunities, internships and competitions.
- Maintain content for our web pages and intranet portal.
- Facilitate recording of CV videos and elevator pitches.
- Manage internal student satisfaction surveys.
- Engage alumni in the national Graduate Outcomes survey.
- Provide destinations information to pre-students deciding on Cranfield.

Our software

- VMock - 24/7 CV critiquing software.
- Symplicity – online career management portal, live appointment system, vacancy database.
- Intranet portal – the place to go to find your physical and digital careers resources.
- Subscription resources – paid-for sites where you can access research information.

Our career continuation service

- Skype, phone and email support for life.
- Ongoing access to Symplicity.
- Invitations to alumni careers and networking events.
- Progress monitoring – contacting you to discover your career outcomes.

For further details, visit:
www.cranfield.ac.uk/study/careers-service

Top tips

Tip 1

Contact a local manufacturer to ask for a factory tour

Most are very accommodating and you might be surprised by the range of roles available.

Tip 2

Don't follow the money

Choose an organisation that offers genuine training, career development and an enlightened culture - the money will follow you in due course.

Tip 3

Work experience is great way of understanding an industry first-hand

If your school or college cannot help, be proactive and contact a few local employers asking for an opportunity.

Tip 4

Make your own decision

Listen to teachers, parents and friends but by all means there are plenty of online resources available for you to make an informed career decision.

"Cranfield students are world-renowned for being the best from a manufacturing and management perspective. The fact that they want to study at Cranfield University shows that they have a commitment to their industry, their education and their career as well."

Neil Gibson, Technical Manager,
Crane Building Services and Utilities

Did you know?

1. **Cranfield Manufacturing industrial partners sponsor real life projects to give our students hands on experience for 60% of their course which is extremely important as a learning opportunity.**

2. **Cranfield has approximately 4000 square meters of near industry scale manufacturing research facilities on Cranfield campus alone which is significant in the higher education sector.**

3. **Cranfield is fifth for mechanical, aeronautical and manufacturing engineering education in the UK (eleventh in Europe).**

   QS World University Rankings 2018

4. **Cranfield's Wire Arc Additive Manufacturing (WAAM) was the winner of 3D Printing Industry Awards 2019, for work with BAE Systems.**

5. **Cranfield University works with over 1,500 businesses and governments based in over countries**

6. **In 2019, Cranfield were honoured to receive a commemorative award from the Institute of Materials, Mining and Minerals for course accreditation for over 15 years.**

7. **Cranfield has been ranked UK no.2 for graduate employment*, securing jobs in some of the world's best known companies and organisations.**

   ** DLHE longitudinal 2019*

8. **Cranfield is UK No.1 for teaching staff to student ratio 1:7.**

   Higher Education Statistics Agency (HESA) 2017-2018

9. **Cranfield is ranked No.1 in the UK for engineering master's students.**

   Higher Education Statistics Agencey (HESA) 2017-2018

Where do our manufacturing students go after graduating?

Here is a list of just some of the multinational organisations our graduates go on to work for:

- Amazon,
- Amundi,
- AVIC,
- Babcock International,
- BAE Systems,
- BNP Paribas,
- Boeing,
- Bombardier,
- BP,
- Deloitte,
- EDF,
- Exxon Mobil,
- Ford Motor Company,
- GSK,
- Hindustan Aeronautics,
- Hitachi Rail Europe,
- Huawei,
- Maersk Line,
- Mott Macdonald,
- Nestle,
- Procter & Gamble,
- PwC,
- Renault,
- Rolls-Royce,
- SARFRAN,
- Singapore Technology Aerospace,
- UTC Aerospace Systems,
- Volvo Construction Equipment.

Our manufacturing alumni go on to work in employment all over the world including (but not limited to) companies based in:

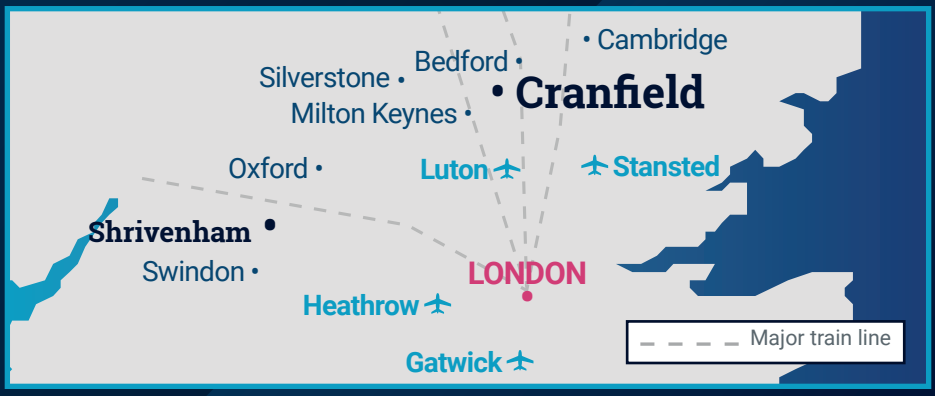
- Belgium,
- Canada,
- China,
- France,
- Germany,
- India,
- Italy,
- Malaysia,
- Singapore,
- Spain,
- UK,
- USA.

This data has been taken from information we hold from the 2014, 2015 & 2016 HLHE (Destination of Leavers from Higher Education) surveys.

Location

How to find us

Cranfield University is located about halfway between London and Birmingham, and on the outskirts of Milton Keynes. Junctions 13 and 14 of the M1 are five minutes away and Milton Keynes railway station is 20 minutes away by taxi. London Luton, Stansted and Heathrow airports are 30, 90 and 90 minutes away respectively by car, offering superb connections.



Manufacturing courses at Cranfield University

Manufacturing systems and management

- Aerospace Manufacturing MSc,
- Cyber- Secure Manufacturing MSc,
- Engineering and Management of Manufacturing Systems MSc,
- Global Product Development and Management MSc,
- Management and Information Systems MSc,
- Maintenance Engineering and Asset Management MSc,

Manufacturing technology and materials

- Advanced Materials MSc,
- Aerospace Materials MSc,
- Manufacturing Technology and Management MSc,
- Metal Additive Manufacturing MSc,
- Welding Engineering MSc.

Open Day

Find out more about how Cranfield can help to develop your career in manufacturing at our next open day.

www.cranfield.ac.uk/events/open-day

www.cranfield.ac.uk