

Learning Advanced Industrial Technologies (LAIT). What are advanced industrial technologies?

Britain led the way with the first industrial revolution when power from steam engines replaced manual effort; one of the first industries to benefit was widespread in this area: textiles.

Electricity and specialism of labour were the drivers of the second industrial revolution when rates of production increased significantly; early mass production limited choice “any colour you like as long as its black”.

The third revolution has been with us since perhaps the 1950s - the digital or information age, with advances in computers and communications, is well known to us all.

Some might say we are on the cusp of the next Industrial Revolution: several digital technologies have now reached a high level of sophistication; they have advanced capabilities - at low cost - to enable what is being called the fourth industrial revolution - Industry 4.0 - where manufacturing, automation and communications are converging

What are these technologies? And so what? What difference will this make to me - to us - as lecturers and workforce developers here at Dundee and Angus College? We will begin to explain advanced industrial technologies - Industry 4.0 - here, this afternoon.

Industry 4.0 and ICT will change jobs significantly in the next 5-10 years. There is a recent government report that says that we should be prepared (seen on mainstream

news earlier this week). And we here at the college should be prepared. We should ensure our students and learners are prepared; and this intent underlines the LAIT project. We will also help SMEs in our community to be prepared; there will be another workshop in the new year and engineering companies in our community will be invited.

Industry 4.0 - Background

A little about the history; there was a report published in 2013 that recognised the recent historical accomplishments of German industry where academia and research are closely linked to production and industrial processes. This might be seen as a defensive move (against Asia and USA) to maintain the position of their manufacturing industry - and has the backing of Chancellor Merkel. The fourth Industrial Revolution was envisaged, where “Cyber Physical Systems comprise smart machines, storage systems and production facilities capable of **autonomously** exchanging information, **triggering actions** and **controlling** each other independently”.

The lead author subsequently presented the main findings here in the UK (in 2014) - a paradigm shift there is greater customisation and flexibility in manufacturing, significantly increased productivity achieved with significantly fewer resources and a work-life balance taking account of availability of individual workers.

Ceed (the Centre for Engineering Education and Development) will come together with a UK engineering controls and instrumentation company and will be communicating the “basics of Industry 4.0 and digitalisation” to a Scottish audience

Today, there are local engineering companies who understand the advantages of Industry 4.0, for example GA Engineering and SP Technologies in Dundee.

The UK's emerging industrial strategy "Made Smarter" made mainstream news earlier this week and "highlights the benefits of robotics, 3D printing and artificial intelligence"; the author stated "UK needed 'greater ambition' to take advantage of such technology"; and a huge number of workers would need to be retrained". The impact could be significant - if we get it right - 175,000 jobs, 4.5% reduction in CO2 emissions and £455bn for UK manufacturing.

Industry 4.0 - The Drivers

Reduced costs, increased flexibility during manufacturing and greater customisation of products; competition in a global marketplace and consumer demands all driving improvements to design and manufacturing; Industry 4.0 enables tighter integration of design and manufacture - real-time design refinements are possible and "self-aware" factories generate large volumes of information which is used to feedback into the manufacturing process to reduce downtime and maintenance costs, lower stocks and improve logistics.

Industry 4.0 - The Technologies

- Additive Manufacturing
Probably better known as 3D printing. There are several different processes from extruded plastics at the more affordable end of the market to metallic powder / laser sintered which are expensive; hobby machines are available for a few hundred pounds to several tens or hundreds of thousands for high end, professional manufacturing
Physical 3D components are built; layer by layer, with material deposited under control of the computer.

Ideal for very small batch sizes and complex / difficult to manufacture shapes (eg Bloodhound steering wheel in titanium)

- Cyber Physical Systems (Simulation)
- Cloud Computing
Distributed network of storage, processors and applications - out there, somewhere and its location is of no particular importance or relevance to the end user. What is important is security, availability, processing speed and the required applications.
- AI & Machine Learning
- Big Data and Advanced Analytics (including Predictive Analysis)
- Industrial Internet of Things (including sensors)
- Collaborative and Autonomous Robotics
- Augmented Reality (for example; engineer in the field when presented with a problem might receive instructions and training - the correct procedure superimposed over image of the equipment)
<https://www.youtube.com/watch?v=JSXQ7W7P96U>
- Machine Vision (REF: lidar)
- Cyber security

Industry 4.0 - Difficulties (or) Obstacles

As with any new technologies and developments there are difficulties and Industry 4.0 is no different.

Firstly there is a **lack of understanding** in the UK of Industry 4.0, its potential benefits and how it might be implemented.

Implementation of Industry 4.0 will need to be planned carefully and account for training and recruitment of suitably qualified and experienced engineers with digital expertise (this was identified as barrier No 2 ref: Made Smarter 2017). There is **already** a shortage of digital skills in the UK and as technology develops this will only be exacerbated. It has been estimated that, within 20 years, 90% of all jobs will require digital skills.

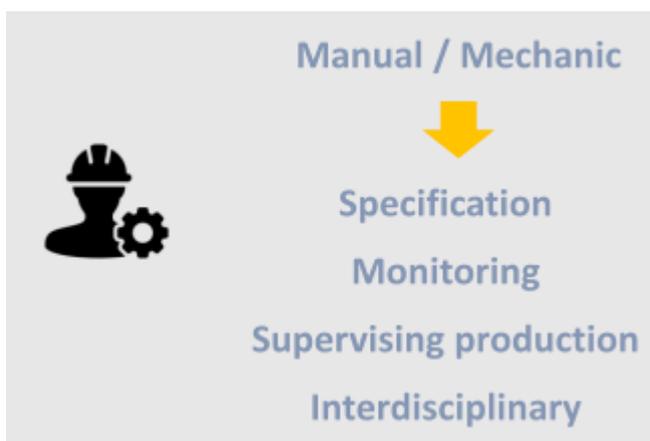
Support from government and education sectors.

This is not yet a mature activity; there are rapidly evolving solutions and current vendors may not survive in the long term, although any concerns regarding continuity would be mitigated somewhat by **standardisation**.

The very nature of production i.e. its diversity means there are many and varied solutions to problems. There are moves to standardise Industry 4.0 platforms (such as RAMI 4.0)

Cybersecurity (voted top barrier (Made Smarter 2017)). With large companies and organisations not immune (for example Yahoo, Talk Talk, Equifax, NHS) being subjected to cyber attacks recently SMEs might need some careful persuasion to, in effect, rely and depend heavily on the internet for their livelihood. Obviously providers of connected devices will need ensure privacy is protected.

Impact on jobs, social cohesion. Are people the most adaptable component of Industry 4.0? TED Talk re: AI / Machine Learning



Often stated that the nature of work will change in future; will we have more time for leisure? What about those without jobs / universal basic income

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What personal attributes will be in demand in the age of Industry 4.0?

Industry 4.0 - New Business Models

As there is significant change in manufacturing; traditional business models are being replaced with a plethora of alternatives where risk may be shared, partnerships flourish and where there is more focus of the final objectives

Ref: Engineering at The British Library needed to specify The Nations Treasures (including The Magna Carta and 625km of shelving) was to be maintained at given environmental parameters for given times. How the contractors went on to achieve this was not the major concern; it is the end result which is important. Incidentally one of the new storage buildings at Boston Spa in Yorkshire is fully automated, with a low oxygen environment which helps preserve the collections.

The aim of Digital Transformation (or Industry 4.0) is to improve manufacturers' efficiency but may lead to increase in or creation of new revenue streams and this may require the development and implementation of new business models - value propositions arising from the combination of different ways of delivering services

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Automation; there is no getting away from it!