Sustainable Manufacturing
— the next steps

An IET action plan for government, industry, academia, membership organisations and others

CONTENTS

ABOUT THIS REPORT

This IET Sustainable Manufacturing Insight report has been developed through discussion amongst leaders in industry, academia and professional bodies. The successes that pioneers have already achieved, the enablers for change and the actions are taken from a one-day workshop, hosted by the IET's Design and Production Sector in June 2017, and subsequently reviewed and enhanced by the participants. This IET Insight is a thought leadership deliverable from the workshop. Whilst it does not represent IET policy or that of the individuals or organisations represented, it does present the collective sense of urgency felt by leading experts from the UK manufacturing sector.

IET The Institution of
Engineering and Technology

The Institution of Engineering and Technology (IET) is working to engineer a better world. We inspire, inform and influence the global engineering community, supporting technology innovation to meet the needs of society. The Institution of Engineering and Technology is registered as a Charity in England and Wales (no. 211014) and Scotland (no. SC038698).

© The Institution of Engineering and Technology 2017

EXECUTIVE SUMMARY

This report sets out an exciting opportunity for British manufacturing. A post-Brexit UK must develop ambitious but achievable actions that all businesses, government and support organisations can make over a five-year period to create significant financial, environmental and social impacts.

To do so will massively increase resource productivity, build resilience against supply chain shocks, reduce business costs, open up innovation opportunities and win market share globally. Sustainability is a long journey but short-term, mass change is achievable, beneficial and time critical.

The actions against each of the five themes will collectively achieve mass impact across all industrial sectors and supply chain tiers. The specific actions align to the UK's Industrial Strategy, and are stretching and require strength of commitment and leadership to instigate and achieve.

The rewards will be a clear step change, creating world-leading UK performance with significant impact:

- Reduce the UK resource consumption by 5% year-on-year from 2020.

- 100% of large companies, 50% of SMEs and 10% of micro companies achieve circa 8% year-on-year savings.

- Innovation to spawn new industrial systems, business models and products that have no or low or even positive environmental impact.

- Target 100% diversion from landfill to focus on waste reduction, but also change perception from reducing waste to gaining financial benefit from waste processing as a value stream.

- 10% more of UK workforce with fundamental sustainability education every five years.

- Use of the apprenticeship levy fund will implicitly promote sustainability and reach deep within the existing workforce quickly.

- Every company has a sustainability champion and reports on performance publicly at least once a year.

- Membership bodies coalesce to reach most UK companies with standard sustainability toolbox.

- Membership bodies collaborate to share knowledge and good practice to support the advances needed.

- Sustainability becomes intrinsic to thinking within all legislation and moves away from punitive and restrictive policies to incentives that drive improved performance, not just those that set a ceiling on poor performance.

Sustainability refers to the universally accepted three pillars of social, economic and environment. By simultaneously caring for the natural environment, enhancing our communities and securing the financial health of our organisations then the human race can prosper to enable future generations to have at least the same benefits that our current generations enjoy [iii].

37 ACTIONS, 13 IMPERATIVES, 5 THEMES

THEME ONE – ASPIRATION TO DRIVE MASS, VIRAL CHANGE	
ACTIONS	**IMPERATIVE 1: LEADERS MUST DRIVE MASS ADVANCE**
1	Companies aspire to 8% year-on-year reduction in resources. Public targets should be science-based set by trade bodies at sector level.
2	Government legislates that all large company CEOs pass sustainability training to be able to submit accounts to Companies House.
3	Government should encourage companies to publish their sustainability strategy, targets and performance in their annual report. Mandatory carbon reporting must use external standards and not in-house ones, which can lack aspiration.
4	Accreditation panels should encourage academic institutions to embed sustainability into every year of education.
ACTIONS	**IMPERATIVE 2: GOVERNMENT MUST SET EXPECTATIONS**
5	Government sets aggressive sustainability targets in the Industrial Strategy.
6	Government sets standard of behaviour expected for CEOs informed by best practice guides collaboratively produced by membership bodies.
7	Government sets science-based triple bottom line reporting expectations.
ACTIONS	**IMPERATIVE 3: NATIONAL CHAMPIONS MUST BE APPOINTED TO INSPIRE CHANGE**
8	Companies must appoint a sustainability champion at board level informed by best practice guides produced collaboratively by membership bodies.
9	Government appoints and funds five national industrial sustainability champions to drive national capability.

THEME TWO – MEASUREMENT AND BENCHMARKING	
ACTIONS	**IMPERATIVE 4: AMBITIOUS TARGETS FOR IMPROVEMENT MUST BE AGREED**
10	Each industrial sector to agree ambitious targets for improvement in line with science-based targets set by trade bodies at sector level. Performance against the targets should be published at least yearly.
11	Government to align industrial strategy to support each sector in their improvement target.
ACTIONS	**IMPERATIVE 5: BENCHMARKING TO DRIVE STANDARDS**
12	Government to fund establishment of national benchmarking service that links to the Climate Change Act and the UN's Sustainable Development Goals.
13	Government to fund operation and validation of the benchmark service.
14	Government to encourage business to engage in submitting data and acting on outcomes.
ACTIONS	**IMPERATIVE 6: SUCCESS TO BE CELEBRATED**
15	Membership bodies and media collaborate on single national award scheme for individuals, companies and supply chains.
16	Business and membership bodies to fund prize for annual national sustainability challenge.
17	Government award honours for sustainability leaders annually.

THEME THREE – TOOLS FOR CHANGING PRACTICE	
ACTIONS	**IMPERATIVE 7: A TOOLBOX THAT SPANS ALL BUSINESS DISCIPLINES**
18	Academia to collaboratively create national open-source toolbox from industry best practice.
19	Business and membership bodies provide their intellectual property to enhance toolbox.
20	Membership bodies form coalition to accredit tools in the toolbox.
21	Membership bodies become custodians of toolbox and enhance it.
ACTIONS	**IMPERATIVE 8: PLATFORM CREATED TO SHARE TOOLS AND PRACTICES**
22	Government appoints and funds professional institutions to establish toolbox route to market and maintenance.
23	Membership bodies provide cross-sector guides on best practice.

THEME FOUR – COMMUNITY FOR SHARING: KNOWLEDGE, SKILLS, EDUCATION.	
ACTIONS	**IMPERATIVE 9: SHARING CULTURE, THE BUDDY SYSTEM AND SWAT TEAMS**
24	Sustainability champions in each business provide access to other businesses to share practice.
25	Government provides national funding to second champions into their suppliers, customers or neighbours.
26	Government nationally provides funding to regions to fund small 'SWAT' teams to advance practice, preferably ring-fenced within existing industry support structures.
27	Professional institutions franchise training providers to deploy the sustainability toolbox.
ACTIONS	**IMPERATIVE 10: SUSTAINABILITY EMBEDDED INTO ALL LEVELS OF EDUCATION**
28	Every education institution must embed sustainability into every year of a pupil/student's education, informed by best practice guides produced collaboratively by membership bodies.
29	Professional institutions (e.g. business and engineering) only accredit education provision where sustainability is truly embedded.

THEME FIVE – CLIMATE FOR SUPPORT: LEGISLATION, INCENTIVES, INITITAVES	
ACTIONS	**IMPERATIVE 11: PUBLIC SECTOR PURCHASING STANDARDS RAISED**
30	Government procurement must demand ISO14001, ISO50001, Planet care company.
ACTIONS	**IMPERATIVE 12: FINANCIAL INCENTIVES DRIVE INVESTMENT AND BEHAVIOUR**
31	Government provides green investment loans with 0% interest for a period compatible with the significance of the investment.
32	Government encourages apprenticeship levy use on sustainability education. New apprenticeship trailblazers must have sustainability embedded in the standard.
33	Government gives VAT incentives for products with reused and recycled content (VAT only on virgin materials) and tax breaks for zero waste to landfill enterprises.
34	Government gives export rebate on green products.
35	Achieve single carbon price within five years.
ACTIONS	**IMPERATIVE 13: MINISTER FOR SUSTAINABILITY CREATED**
36	Government appoints a Minister for Sustainability who links with the existing structure of the Department for Business, Energy & Industrial Strategy (BEIS).
37	Department for Sustainability informs all new bills including customs, trade, agriculture and fisheries.

EXEMPLARS

There is urgency to act on industrial sustainability in the UK in a post-Brexit era (Smart et al, 2017). Champions (such as Interface, M&S, Toyota and Unilever to name a few) are recognised by customers and wider consumers as leaders and innovators, and build trust and brand loyalty.

Their achievements have been so impressive their competitors have had to follow. Those leaders are coming together to form a significant minority, voicing a new narrative for greater resource productivity, and working ambitiously towards UN Sustainable Developments Goals [i].

Leading companies make progress because inspirational leaders mobilise their employees to make numerous incremental advances that build to be radical transformations. The climate for this at a national scale is pressing. A key message has to be an ability to demystify the debate on sustainability that keeps some companies on the starting blocks, seeking direction whilst others take a strong leap forward and realise commercial, environmental and social advantage.

THE CHALLENGE AHEAD

There is urgency to act on industrial sustainability in the UK. Sustainability in this context reflects the triple bottom line approach in addressing: People, Profit, Planet or Social, Financial and Environmental issues and opportunities (Elkington, 1999). The benefits to companies start with reducing costs and quickly develop into building resilience to supply chain shocks, building customer loyalty, developing new market opportunities and contributing to the health of workforces and the communities they operate within.

Many companies start by focusing on the bottom line by reducing cost, then realise the greater advantages in addressing innovation, market leadership and building resilience to strengthen the "top line". We still have a perceived abundance of materials but need to protect ourselves against shortages driven by inability to purchase those materials or their physical exhaustion. The significance of the risk of climate change impacting locally and globally is now so great that the risk of not reacting far outweighs the perceived costs of acting.

The World Business Council for Sustainable Development (WBCSD) shows there are many successful leaders in the sustainability space. Manufacturing sites in the UK can boast up to 10% year-on-year cost reductions in energy, water and many other resources [ii].

Those same companies are recognised by customers and wider consumers as leaders and this builds trust and brand loyalty. This is no coincidence. Whilst we should applaud their bottom line resource efficiency achievements, we should marvel at their ability to strengthen their competitive position to become global leaders. They have created a situation in which their competitors have no choice but to follow.

Those champions are striving to strengthen the resilience of their supply chains and operate in a more caring and ethically sound way globally. They have moved on from seeing lean as about less waste to adding value. They have moved on from seeing environmental protection as about less bad to more good. They are now seeing social advances about less harm to greater social capital. That minority of leaders will continue to be successful. It is the other companies in the UK that need our attention. It is the majority of followers who need support to enable rapid mass change.

THE NEED FOR MASS CHANGE

The change will benefit UK companies individually in the short-term and in the long-term. The change also aligns with the Industrial Strategy to benefit the resilience of the UK's economy and supports its international competitiveness. Or should we wait?

All businesses improve year-on-year and they can expect to be able to react, if needed. There is a background rate of environmental improvement in the UK even if productivity generally has stagnated. The sustainability journey can be misconstrued and there may be a perception that the financial cost is prohibitive.

But there is ample evidence to show that this is not true as it misses the competitive advantage enjoyed by the leaders, the cost reductions, the social benefits and the financial benefits they have reaped.

Few, if any, leading companies have 'armies of sustainability professionals' and few think of themselves as having a wealth of resources at their disposal. Most leading companies make progress because inspirational leaders mobilise their community of fellow employees to make numerous incremental advances that build up to bring radical transformations that help them become and remain leaders [iv].

There needs to be a shift in mindset from cost and resource availability to one of purpose and resourcefulness. Sustainability should not be considered a 'cost' but rather an 'investment'.

SETTING THE STANDARD

Setting a sustainability benchmark is key. At present, government emissions targets are not aligned with science-based targets (Science-based targets, 2017) and are in fact much lower in absolute terms than we require to meet those targets – allowing offsets rather than requiring real emissions changes is an example of how we miss the most important part of the target.

On the surface, such targets (57% saving from 2010-2025 for 'other industries') can appear onerous for companies to achieve who are currently not even achieving the lower climate change agreement targets. However, to make a real impact companies need to seek technological solutions that already have the capability of making a step change in emissions that would fast-track the UK adherence to its UN climate change obligations.

Government support through the Feed in Tariff and Renewable Heat Incentive schemes need also to keep pace with industry drive in these areas where they are essential to making the financial case.

There are many solutions to our sustainability challenges that include the 'circular economy', 'Industry 4.0' and renewable energy to name a few. The urgency in the short-term is not to develop these solutions further. Innovative companies will do this regardless. The urgency is to develop an ambition for change and a climate to support the adoption of these solutions. Helping all companies to develop their ambitions, develop their targets, deploy tools and gain benefit is more urgent in the short term.

NATIONAL PROGRESS

We have much to celebrate within industry and across the UK generally, as well as further afield, on what has been achieved. These achievements demonstrate that major change is possible. The past achievements, like those in leading companies, serve to inspire significant future successes.

Within the UK there has been significant progress to de-carbonise the UK energy supply. There was a 38% reduction in total greenhouse gas emissions between 1990 and 2015 [vi].

20% of electricity now comes from renewables [v] and renewables now accounts for more than coal in generation [vii].

Much progress has been made to divert waste from landfill and many corporates now boast zero waste to landfill. There has been significant work on the circular economy and excellent examples - some longstanding - exist on how to retain value in our industrial system and not allow valuable materials to go into waste streams.

From a policy perspective, significant changes have taken place including the Climate Change Act, which created the legally binding target to achieve an 80% reduction in greenhouse gas by 2050 against a 1990 baseline (CCA, 2008) and ESOS, with an estimated £1.6bn net benefits to the UK being directly felt by large businesses as a result of energy savings (Environment Agency, 2012).

There have been helpful regulations around packaging and product labelling as well as the Social Value Act (SVA, 2013) to broaden public services to consider the three sustainability pillars (social, environmental, economic). Such changes will drive ambition for detailed change.

INDUSTRIAL PROGRESS

It is clear from businesses that the sustainability agenda is now represented in the boardroom. The chief sustainability officer is now a feature of the FTSE100 boardroom. There is increasing visibility of businesses making changes that benefit themselves, their customers and the environment, whether that 'environment' is local or on the other side of the globe.

Most importantly there is recognition that environmental performance is not a costly trade-off, nor is it an issue of bureaucratic compliance. It is now being used to achieve competitive advantage through cost reduction and market growth.

Companies now display on their website their awareness and achievements and in some cases their performance against target. Perhaps some now leave their achievements hidden behind advances in efficiency and innovation.

SOCIAL PROGRESS

Socially the picture has changed dramatically. From NGOs to the general public there is pressure for business and government to change: we see energy labelling on goods and houses as the norm; recycling and waste segregation is now an expectation; an expectation that our countryside and rivers will be cleaner and support richer life; food waste is increasingly seen as not acceptable; awareness of the activities of our brands grows; a greater degree of safety expectations of materials used in buildings, tools and equipment and in the provenance of consumer goods.

There is still a dramatic disconnect between sustainability requirements from the CEO or CSO (Chief Sustainability Officer) and those responsible for procurement. A step change in the ethos of the buyer is required to make sustainability a KPI in choosing suppliers. This requires a step change in direction from CEOs who must show commitment to the dual targets of sustainable manufacturing and financial benefit – they are inseparable for successful companies.

Elvis & Kresse craft luxury bags from reclaimed London Fire Brigade hoses, returning 50% of profits to communities through charity donations.

THE NEXT STEPS

These transformations and significant achievements have occurred over many decades of change in government, industry and the wider public. The revolution needs to continue to reduce environmental impact, increase social value and create competitive advantage for our industry.

To proceed at a much faster rate and engage with companies to create a significant short-term impact, what urgent actions are needed in the next two years, in order to deliver impact within the next five years?

The IET Design and Production Sector workshop has identified an action plan for government, industry, academia, membership organisations and others. The plan identifies five core themes, 13 imperatives and a set of 37 actions which, if taken in totality, will accelerate the rate and depth of change required.

Responsibility for securing these actions is split across industry, government, professional institutions and academia. By collectively addressing these urgent actions, significant change can be achieved across the breadth of manufacturing industry.

These actions are linked. 'Cherry-picking' will not be effective for mass change, or create the impact required. Securing many of these actions will not be easy. Many will involve a difficult transition.

Perhaps we should look back at the introduction of car seat belts, unleaded petrol, national minimum wage, the smoking ban, sugar tax and others. These were difficult decisions on personal freedoms and market freedoms. Few would now look back and consider them anything other than the right decisions.

ASPIRATION
to drive mass viral change

MEASUREMENT
and benchmarking

TOOLS
for changing practice

COMMUNITY
for sharing

CLIMATE
for support

ASPIRATION TO DRIVE MASS, VIRAL CHANGE

First and foremost, there must be a national aspiration to undertake mass change in the pursuit of responsible business practice. This thinking is essential to significantly reduce our excessive burdens on the environment.

Aspiration is essential to drive mass, viral change. The urgency in the short-term is not just to support the development of technical solutions. Innovative companies will do this, regardless. The urgency is to develop the aspiration for change and to build a climate to support it.

We must set the bar high to achieve the rate and magnitude of change that is sensibly achievable. Leading companies have clear visions of where they aspire to be and have set impressive targets for improvement and have achieved them.

Our leading companies celebrate their impressive improvements and are willing to share their routes to success and where they are finding it challenging to make progress. Their achievements are admirable and carry untapped momentum of social proof, which can be used to set about a national aspiration to help all enterprises progress at the same rate.

Aspiration for change can come from many sources. CEOs have to want this and management teams and investors must support them. We must show that improvements help to reduce risks, build resilience and provide competitive advantage.

Some of actions asks will be challenging to communicate and the role of inspirational public faces is invaluable here. It is not difficult to quickly list media stars who communicate complex issues of the natural world, physical science, medicine and food; there is an opportunity for industry here too.

Competitive behaviour of companies will result in a modest 'background rate' of savings year on year. The benefits will be skewed towards the leaders and will be insufficient to reach the savings required by 2050.

Mass change across all companies will build UK resilience and enhance competitive advantage. Most companies have 'good days' of efficiency. Helping companies have 'good days' as a matter of course is viable and essential. The emphasis here is on scale but is not to help the leaders alone; the focus is helping the mass of industry get towards leaders' levels of performance.

We need to know what good looks like and invest in human capital to drive the change forward. Change may be on energy or water use or the largely neglected material productivity (Despeisse, et al, 2013). It should extend beyond the efficiency agenda to mass change in both production methods as well as business models. The change should be mass, perhaps viral.

IMPERATIVE 1

LEADERS MUST DRIVE MASS ADVANCE

Individuals and companies must embrace the urgency to undertake a mass transformation of our industry to ensure that it is resilient and competitive in the years to come.

ACTION 1

Companies aspire to 8% year-on-year reduction in resources. Public targets should be science-based set by trade bodies at sector level.

Note: 8% year-on-year improvements have been demonstrated by lean manufacturing companies. Those same levels of savings have been demonstrated by companies leading in the sustainability space. Leading companies still find opportunities for further savings, showing that a continuing flow of improvements is possible, and not just a one-off temporary improvement.

ACTION 2

Government legislates that all large company CEOs pass sustainability training to be able to submit accounts to Companies House.

ACTION 3

Government should encourage companies to publish their sustainability strategy, targets and performance in their annual report. Mandatory carbon reporting must use external standards and not in-house ones, which can lack aspiration.

ACTION 4

Accreditation panels should encourage academic institutions to embed sustainability into every year of education.

Note: Accreditation panels are those that provide external verification of education courses meeting the national and global standards. Such panels emanate from organisations such as professional engineering institutions and management institutes.

IMPACT

100% of large companies, 50% of SMEs and 10% of micro companies achieving an 8% reduction in resource consumption year-on-year would reduce the UK resource consumption by around 5% year on year from 2020. Put another way, we would only need 75% of our current energy needs by 2025.

IMPERATIVE 2
GOVERNMENT MUST SET EXPECTATIONS IN OUR INDUSTRIAL STRATEGY

The UK Government's Industrial Strategy should present the sustainability imperative as an intrinsic value adding enhancement to competition advantage.

ACTION 5

Government sets aggressive sustainability targets in the Industrial Strategy.

ACTION 6

Government sets standard of behaviour expected for CEOs informed by best practice guides collaboratively produced by membership bodies.

ACTION 7

Government sets science-based triple bottom line reporting expectations.

IMPACT

Sustainability advancement communicated as normal in the competitive landscape.

Membership bodies is a broad term referring to organisations that represent the interests of professionals (for example, the Institution of Engineering and Technology or the Institute of Environmental Management & Assessment) or enterprises.

IMPERATIVE 3
NATIONAL CHAMPIONS MUST BE APPOINTED TO INSPIRE CHANGE

Change occurs through people. Leaders of change programmes can foster more and wider advance than background rates of change.

ACTION 8

Companies must appoint a sustainability champion at board level informed by best practice guides produced collaboratively by membership bodies.

ACTION 9

Government appoints and funds five national industrial sustainability champions to drive national capability.

IMPACT

Change agents will drive all to reap benefits achieved by the leaders. Even with a lower aspiration of an additional 1% more annual benefit than the 'background rate' then 5% more UK resource saving could be achieved by 2025.

Note: Five champions is considered the minimum number of experts to be able to cover the geographical breadth of the UK and to support and celebrate the significant volume of activity required.

THEME TWO

MEASUREMENT AND BENCHMARKING

Measurement and benchmarking requires prompt action to achieve short-term, lasting impact. Helping all companies to develop their ambitions, measure against their targets, deploy tools and gain benefit is the highest priority in the short-term.

Through measurement and benchmarking companies can establish their current position and set targets against national best practice benchmarks.

Perhaps it is a bit tiresome to repeat the phrase about "what gets measured gets done", however, if we have high aspirations we must put these into numbers and share our progress in working towards them.

For industry leaders in sustainability the phrase is more accurately "what gets measured and can be made more efficient gets funded." Leading companies publish their targets and performance. If all companies did this publicly then the opportunities to benchmark and learn from one another are immense.

Many sectors already do this in private and there would be enormous value to all if this was more open and followed a standard. Any benchmarking system would need to be quality assured, robust, clear and easy to use.

Measurement is an essential starting point for change. Knowing how much resource is used or what impact operations are having on the environment will trigger the move to change. By benchmarking against others, the performance gaps provide focus and urgency for change.

Potentially, the benchmarking could become league tables. Funding of a national measurement scheme would provide a high quality, trusted means of measurement. By assessing not just our manufacturing systems but our leaders too then we can reward and celebrate excellence to inspire others.

IMPERATIVE 4

AMBITIOUS TARGETS FOR IMPROVEMENT MUST BE AGREED

It is insufficient for individual companies to set targets alone. Federations and institutions that represent national sectors should work together with government support to encourage change in those companies. Government should ensure that sectors set reasonable targets.

ACTION 10

Each industrial sector to agree ambitious targets for improvement in line with science-based targets set by trade bodies at sector level.

Performance against the targets should be published at least yearly.

ACTION 11

Government to align industrial strategy to support each sector in their improvement target.

IMPACT

Sector targets will aid communication of change necessary. Some sectors will target more than 8%-per-year improvements.

IMPERATIVE 5
BENCHMARKING TO DRIVE STANDARDS

Knowing what is best leads to better understanding of performance gaps, drives aspiration to improve and allows improvement to be focused where it will be most effective.

ACTION 12

Government to fund establishment of national benchmarking service that links to the Climate Change Act and the UN's Sustainable Development Goals.

ACTION 13

Government to fund operation and validation of the benchmark service.

ACTION 14

Government to encourage business to engage in submitting data and acting on outcomes.

IMPACT

Leaders of change will be able to focus on areas of greatest potential and meet the timescales for change.

IMPERATIVE 6
SUCCESS TO BE CELEBRATED

We regularly celebrate success but through collaboration at a national level, excellence will be celebrated to reach more companies as well as the general public. With open reporting and networks of sustainability champions nominations can reach inside companies to ensure CEOs are not the only individuals considered for awards.

ACTION 15

Membership bodies and media collaborate on single national award scheme for individuals, companies and supply chains.

ACTION 16

Business and membership bodies to fund prize for annual national sustainability challenge.

ACTION 17

Government award honours for sustainability leaders annually.

IMPACT

Competition for awards will drive innovation and aid collection of best practice to inspire others.

TOOLS FOR CHANGING PRACTICE

To change practice, industry needs tools. The provision of a universally accepted toolbox will give individuals in companies a sound benchmark against which they can drive change and strengthen their company's competitive position.

Tools are the means by which we achieve change. They can support analysis and aid communication. Lean manufacturing tools are universally used by manufacturers, with professionals helping one another in a common language around a common toolset.

Rapid change can be achieved across industry if simple, effective, universally accepted tools are provided and supported. Tools can be used to identify hot spots to focus our attention on the areas of greatest benefit or risk.

Using a common toolset will allow a common language to communicate across business functions and across supply chain tiers. Tools can enable manufacturers to make more out of what they have and focus more on resource productivity using their existing skills on labour productivity and throughput. Like with standard lean manufacturing tools, each company can adapt them to suit their particular needs but still align to the universal language.

Leaders are the drivers of change[iv]. Tools enable leaders and their teams to measure that change. Tools enable others to copy practice and to apply change repetitively. Regular users of tools become masters of their application and some users will enhance those tools to be even more effective.

Some business tools (e.g. those in lean manufacturing, business strategy, market analysis to name a few) are pervasive in UK manufacturing. Professionals moving from business to business use the same universally accepted tools to great effect. Sustainability standards and effective tools need to be created, assembled into a toolbox and disseminated.
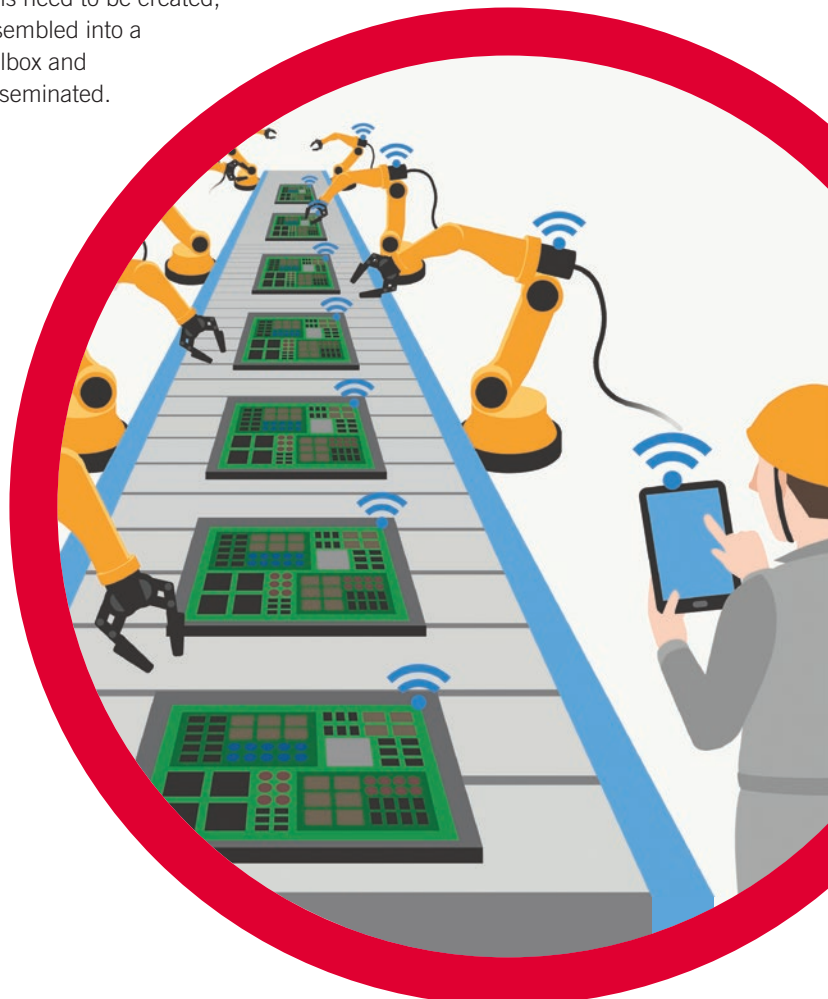
IMPERATIVE 7

A TOOLBOX THAT SPANS ALL BUSINESS DISCIPLINES

Professional institutions are masters of standards and understand the language of their members. If academia, business, professional institutions and industry membership bodies collaborate on an open-source toolbox and its maintenance, then barriers for progress within individual companies between different professions will be broken down. We must create a brand (akin to lean and six sigma) around the toolbox and use standard sales techniques to achieve wide adoption.

ACTION 18

Academia to collaboratively create national open-source toolbox from industry best practice.

ACTION 19

Business and membership bodies provide their intellectual property to enhance toolbox.

ACTION 20

Membership bodies form coalition to accredit tools in the toolbox.

ACTION 21

Membership bodies become custodians of toolbox and enhance it.

IMPACT

The universal language of a simple yet effective toolbox gives independence to companies in their application and simplifies support from outside. Best practice flows more readily and more quickly between companies.

IMPERATIVE 8

PLATFORM CREATED TO SHARE TOOLS AND PRACTICES

Here we should draw on the rapid dissemination of apps witnessed with smartphones and open-source operating systems such as Linux and Android. Once a platform for quality tools is created then dissemination is rapid.

ACTION 22

Government supports and funds professional institutions to establish toolbox route to market and maintenance.

ACTION 23

Membership bodies provides cross-sector guides on best practice.

IMPACT

Membership bodies, including professional institutions, reach into most companies through individual professional and company registrations. Their reputation for industrial support and upholding standards will enable rapid dissemination of the toolset necessary to achieve the scale of change required.

THEME FOUR

COMMUNITY FOR SHARING: KNOWLEDGE, SKILLS, EDUCATION

Sharing knowledge, skills and education is vital. Through the formation of a community that collaborates and demands high standards, the level of knowledge, skills and education of our engineers and other industrial colleagues can be advanced and that advance can be accelerated.

The availability of tools to support best practice adoption is just one of the building blocks. The knowledge of how to use those tools both technically and organisationally for maximum benefit needs to be communicated.

A community of practitioners can enable rapid deployment of tools and lead to new partnerships and innovations generally. Collaboration is possible and some sectors and areas of the UK currently achieve this much more readily than others.

Such communities are slow to form if left unsupported and driving practice at a regional and local level through experienced champions is essential for fast progress. Education and training at all levels is instrumental in ensuring change sticks.

We must not only fundamentally embed sustainability into our formal education systems but also deploy that education and associated training into the professionals across functions in each company and across all companies.

A much more passionate and innovative approach to education is required to create champions who understand industrial systems as systems and not just individual companies to optimise.

Whilst leaders in sustainability are achieving competitive advantage, most industry has not advanced to reap such benefits. There is an urgent need to disseminate practice to those in industry as well as those who will soon enter to be the future leaders.

Those leaving education in the next 5 years could still be in industry in 2070. Those already in the work place are unlikely to re-enter education and they must be supported directly. We must learn to share knowledge through development programmes and the use of standard tools.

A coherent narrative across learned societies, use of buddy systems and open houses will aid rapid dissemination and application. We must learn how to achieve savings at scale. Aspiration for the savings would be expected to be around 8% year-on-year.

A great example of a circular city in action, Sharepeterborough.com is a free online sharing platform where businesses in the City can exchange products, skills, services and underutilised resources with each other.

IMPERATIVE 9
SHARING CULTURE, THE BUDDY SYSTEM AND SWAT TEAMS

Change occurs through people. Leaders of change programmes can foster more and wider advance than background rates of change. Successes seen in lean manufacturing should be copied but on a much greater scale.

Through greater openness of company activity, informal sharing can also evolve through different company types local to one another as well as brokered by sustainability champions. The community of experts enables the standard tools to be rapidly disseminated as well as supporting each other on any company- specific tailoring that is required.

ACTION 24

Sustainability champions in each business provide access to other businesses to share practice.

ACTION 25

Government provides national funding to second champions into their suppliers, customers or neighbours.

ACTION 26

Government nationally provides funding to regions to fund small 'SWAT' teams to advance practice, preferably ring-fenced within existing industry support structures.

ACTION 27

Professional institutions franchise training providers to deploy the sustainability toolbox.

IMPACT

Rapid dissemination of knowledge through champions and training providers enables the UK to meet the timescales for change.

IMPERATIVE 10
SUSTAINABILITY EMBEDDED INTO ALL LEVELS OF EDUCATION

Young leaders of 2025 and beyond are not receiving education where sustainability is an intrinsic part of their academic development. Where education is providing sustainability learning it is typically an add-on part. Not educating on sustainability and not embedding this into the core curriculum should not be accepted. Education is to be interpreted in the widest sense, starting at school level and extending to all types of qualifications.

ACTION 28

Every education institution must embed sustainability into every year of a pupil/student's education, informed by best practice guides produced collaboratively by membership bodies.

ACTION 29

Professional institutions (e.g. business and engineering) only accredit education provision where sustainability is truly embedded.

IMPACT

Every year 1/50 of industrial employees enter the workplace. Every five years this is 10% of our workforce. Mass education of our workforce within existing education programmes would have deep and lasting impact to perpetuate the rate of change required.

THEME FIVE

CLIMATE FOR SUPPORT: LEGISLATION, INCENTIVES, INITITAVES

Creating the right climate of support through legislation, incentives and initiatives will help to nurture industrial change and foster the right climate for investment.

Businesses must be encouraged to invest more in people and technology that drive efficiency and reduce environmental impact. Governments are providing a stable Industrial Strategy that gives business confidence to invest. Whilst legislation can be used to punish offenders, government action can also be used to reward those seeking new market opportunities that are socially and environmentally beneficial.

It is interesting to note that leading companies in the sustainability space have sustainability representation at board level, but we do not do this at the highest levels of government.

Our current industrial fiscal approach is to focus taxation on people and their employment and not the physical resource availability or the resulting environmental damage resulting from using those materials. Incentivising resource efficiency and minimising environmental impact should receive greater attention.

IMPERATIVE 11

PUBLIC SECTOR PURCHASING STANDARDS RAISED

Those companies supplying into the public sector typically trade also with the private sector. Addressing public sector purchasing is a rapid route to mass adoption of new practices.

ACTION 30

Government procurement must demand ISO14001 [viii], ISO50001 [ix], Planet care company.

IMPACT

Rapid uptake of standard systems will be achieved by many UK companies.

IMPERATIVE 12

FINANCIAL INCENTIVES DRIVE INVESTMENT AND BEHAVIOUR

Long-term financial incentives will foster a climate of investment, reduce risk and reward less environmentally damaging behaviours. Encouraging change in products is one route to influencing consumer and general public behaviour.

ACTION 31

Government provides green investment loans with 0% interest for a period compatible with the significance of the investment.

ACTION 32

Government encourages apprenticeship levy use on sustainability education. New apprenticeship trailblazers must have sustainability embedded in the standard.

ACTION 33

Government gives VAT incentives for products with reused and recycled content (VAT only on virgin materials) and tax breaks for zero waste to landfill enterprises.

ACTION 34

Government gives export rebate on green products.

ACTION 35

Achieve single carbon price within five years.

IMPACT

Change in industrial systems will be complemented by changes in product offerings. The significant opportunity to use the apprenticeship levy will enable sustainability education to reach quickly and deeply into our existing workforce.

IMPERATIVE 13

MINISTER FOR SUSTAINABILITY CREATED

The profile of sustainability in government needs to elevate to the same level seen in the boardrooms of our leading companies.

ACTION 36

Government appoints a Minister for Sustainability who links with the existing structure of the Department for Business, Energy & Industrial Strategy (BEIS).

ACTION 37

Department for Sustainability informs all new bills including customs, trade, agriculture and fisheries.

IMPACT

Sustainability becomes intrinsic to thinking within all legislation and moves away from punitive and restrictive policies.

METHODOLOGY

The Institution of Engineering and Technology (IET) brought together leaders and experts from the sustainability space. They were asked to identify ambitious, achievable actions that companies can effect within a five-year horizon to significantly reduce environmental impact, and in doing so reduce their costs, build resilience and open up new opportunities. Whilst sustainability is obviously a long journey but short-term, mass change is critical.

25 leaders contributed to this Insight through a series of progressive workshops examining: what's been achieved to date; what must change presently; what are the barriers and enablers for change; and what government and industry actions are necessary within the next two years, to secure impacts within the next five years.

Notes from the activity of each workshop group were captured as well as their summary briefing to the other groups during the event. These notes were collated, structured and presented as a draft report back to the leaders involved and feedback was used to update the narrative, actions and impact.

The workshop was chaired by Professor Peter Ball (University of York) and prefaced with two presentations to provoke academic and industrial thinking from Professor Steve Evans (University of Cambridge) and John Patsavellas (Altro Ltd).

CONTRIBUTORS

With thanks to all those who participated in the workshop or who provided subsequent feedback. Those individuals whose names can be disclosed are:

NAME	JOB TITLE	AFFILIATION
Peter Ball	Professor of Operations Management	University of York
Martin Baxter	Chief Policy Advisor	IEMA
Caterina Brandmayr	Policy Analyst	Green Alliance
David Burns	Energy Manager	Encirc
Paul Calver	Advanced Manufacturing & Aerospace Specialist	UK Trade and Investment
Fiona Charnley	Senior Lecturer in Circular Innovation	Cranfield University
Nigel Davies	Manufacturing & Sustainability Director	Muntons
Bob Doherty	Professor of Marketing	University of York
Steve Evans	Director of the Centre for Industrial Sustainability	University of Cambridge
Victoria Fleming-Williams	Policy Manager	Aldersgate Group
Rick Greenough	Professor of Energy Systems	De Montfort University
Mark Jolly	Professor of Sustainable Manufacturing	Cranfield University
Andrew Kinder	VP Industry & Solution Strategy	Infor
Greg Lavery	Director	Rype Office & Lavery/Pennell
Peter Lunt	Manufacturing Engineering Manager	Airbus
Gavin Milligan	Group Sustainability Director	William Jackson Food Group
Ben Orchard	Environmental Sustainability Manager	Adnams
John Patsavellas	Manufacturing and Technical Director	Altro
Megan Phipps	Technology Portfolio Manager	HVM Catapult
Clare Porter	Head of Manufacturing Department	BEIS
Palie Smart	Professor of Management	University of Bristol
Louise Sun	Advanced Manufacturing Policy Adviser	BEIS
Mike Tennant	Lecturer in Business and Environment	Imperial College London
Kresse Wesling	Co-Founder, Director	Elvis & Kresse
Margaret Wood	Managing Director	ICW UK

IET The Institution of Engineering and Technology

REFERENCES

i   www.un.org/sustainabledevelopment/sustainable-development-goals

ii   'The Next Manufacturing Revolution: Non-Labour Resource Productivity and its Potential for UK Manufacturing',
www.nextmanufacturingrevolution.org

iii   The IET's 'Sustainable Manufacturing: Starting the journey' Sector Insight
http://digital-library.theiet.org/content/reference/10.1049/etr.2013.9007

iv   The IET's 'Sustainable Manufacturing: Leading change' Sector Insight

v   www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics

vi   www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics

vii   www.enappsys.com/news_and_rep/Q2_2017_Market_Summary.pdf

viii   www.iso.org/iso-14001-environmental-management.html

ix   www.iso.org/iso-50001-energy-management.html

Despeisse, M., Oates, M.R. & Ball, P.D. 2013. Sustainable manufacturing tactics and cross-functional factory modelling,
Journal Cleaner Production, Vol. 42, pp. 31-41.

Elkington, J. (1999) Cannibals with Forks: Triple Bottom Line of 21st Century Business, Capstone.

Environment Agency (2012) Complying with the Energy Savings Opportunity Scheme, Version 2.0, page 7 [The UK government
established ESOS to implement Article 8(4–6) of the EU Energy Efficiency Directive 2012/27/EU (http://ec.europa.eu/energy/efficiency/eed/eed_en.htm).
ESOS came into force in July 2014 under the Energy Savings Opportunity Scheme Regulations 2014
(www.legislation.gov.uk/uksi/2014/1643/made) – referred to in this guidance as "the ESOS Regulations"]

Science based targets, http://sciencebasedtargets.org

Smart P, Hemel S, Lettice F, Adams R & Evans S (2017) Pre-paradigmatic status of industrial sustainability:
a systematic review, International Journal of Operations and Production Management, Volume 37, No 10, pp 1,425-1,450.

World Business Council for Sustainable Development, www.wbcsd.org

www.**theiet**.org