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CONSTRUCTING SMARTER

Seeing is Believing Programme
WorldSkills UK 2019

November 2019

"Continue to support training providers, in conjunction with CITB, to understand the changing needs of the sector and how they can adapt to support the industry."

Contents

FOREWORD

WorldSkills UK works to accelerate the development of young people's skills from national to world-class standards through UK-wide and international competitions. We are part of WorldSkills, a global movement in 82 countries, and together we organise the bi-annual 'Skills Olympics'. This gives us unique access to an expert global community through which we can benchmark and gain insights into the skills needed to drive world-class performance.

Increasingly, we are working to mainstream this learning into the UK skills systems to drive higher standards, developing our methodology on what it takes to become world-class in skills and sharing how other countries in the WorldSkills global network are innovating to meet their economic needs and boost their competitiveness.

The most recent international competition in Kazan, Russia, gave us a great opportunity to pilot a new programme, 'Seeing is Believing', to extend our learning from the WorldSkills global best practice. We were very pleased to work on this with NOCN Group and their partners and to focus on the construction sector, given its well-recognised skills and productivity challenges.

The findings of the programme demonstrate the value that can be gained by sharing experiences and benchmarking with other leading nations. They provide further evidence on how the UK currently compares internationally and what needs to change to improve the skills base of the construction sector, so that it has a more sustainable and productive workforce that is competitive internationally.

Many of the learnings can be applied to other industry sectors and they provide us with a template for future programmes to extend further our understanding of how world class skills can drive excellence in technical education and help boost productivity across the economy. We hope this will encourage more employers and skills leaders to come on board to be part of this global benchmarking community.

As we noted in the WorldSkills UK Construction Roundtable Report "*The future of construction is manufacturing*" (2018), we need to take an "innovation leap of faith". There has been a big question around who takes on the leadership of investing in technology and the future-proofing of the sector from a skills perspective. Given the twin-track approach to skills development, we need to ensure there is a 'research and development' conversation taking place between industry and the education sector.

We look forward to playing our part in taking forward the findings and recommendations.

Dr Neil Bentley-Gockmann OBE
CEO, WorldSkills UK

INTRODUCTION

Like many other UK sectors, construction has seen productivity improvements effectively stagnate since the global financial crisis, compared to our competitor countries. Despite reports such as the *"Farmer Review of the UK Construction Labour Model"* (October 2016) and the efforts of the industry, we seem to be stuck in a mould from which we are still having difficulty breaking out. This is recognised by the sector and more work is needed as set out in the *"Future Skills Report"* (June 2019) by the Construction Leadership Council (CLC).

In the Summer of 2019, we carried out research to understand the current position of the UK construction sector, what our competitor countries are doing and how we can find a way forward by "*Constructing SMARTER*" and accelerating the ideas on SMART[1] construction set out in the CLC's "*Future Skills Report*".

There was a great opportunity to partner with WorldSkills UK through its programme 'Seeing is Believing: Accessing the World's Best Skills Innovations', to enhance and adapt the learning from other countries and build upon the progress the sector has made on skills over several decades. We embedded this programme in our approach to the research as we saw tremendous benefit from such an opportunity to gain real international insight. The research included understanding the UK's productivity issue, seeing what happened at the international WorldSkills event in Russia including meeting with employers and skills organisations from several countries across the globe to share knowledge and understanding. Much of what we found is relevant across many sectors, not just construction.

This report documents the learning on global best practice and sets out recommendations for employers, government and training providers which we hope will contribute to the debate on how we increase productivity in the UK construction industry through improved skills.

Graham Hasting-Evans
Group Managing Director, NOCN

The study team members were (from left to right):

- Braden Connolly,
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We take this opportunity to thank Jill Goodard and other members of the WorldSkills UK delegation for their input and support; including Nigel Leigh (pictured), Principal of Stephenson College.

1. "SMART Construction is the design, construction and operation of assets achieved through collaborative partnerships which make full use of digital technologies and industrialised manufacturing techniques to improve productivity, minimise whole life costs, improve sustainability and maximise user benefits." Construction Leadership Council, June 2019

PRODUCTIVITY CHALLENGES IN CONSTRUCTION

The construction industry is 7% of UK Gross Domestic Product (GDP) and will employ 2.79 million people by 2023. It builds and maintains all our 25 million homes as well as the infrastructure we all take for granted, supporting the day-to-day running of our economy and society. This includes airports, commercial units, hospitals, ports, power stations (including wind farms), railways, retail centres, roads, water treatment and supply, waste water collection treatment and disposal, as well as supporting all the other utilities.

Construction is crucial to our economic success and the running of our society

NEW CONSTRUCTION

Housing
c. 2-300,000 p.a.

Commercial premises

Infrastructures
(airports, ports, power, rail, roads, utilities)

c. £100 billion
p.a. investment

MAINTENANCE

25
million houses

262,300
mls of road plus structures

345,034
km of water mains

566,884
km sewers

15,811
km of rail track

495
power generating stations

40
commercial airports

100,000's
of commercial and utility structures

Like other sectors, construction faces both the opportunity and challenge arising from new digital technologies and Artificial Intelligence (AI).

The industry has continual problems of skills shortages in key trades as well as technical, professional and management levels. Construction does not have a good image as a sector to work in, despite being a very open industry where people can earn good rewards and, with hard work and skills growth, can rise through the ranks.

If the industry is to become more attractive and overcome skills shortages, it needs to change and, as a result of that change, increase productivity.

So, what will be the key drivers of productivity improvements in the sector?

For maintenance and, in part, new construction, the deployment of 'SMART construction' as defined by the Construction Leadership Council (CLC) is key:

- Investment in and adoption of new digital tools and equipment;
- Investment in and adoption of new materials and related methods; and
- Investment in improving the productivity of 'traditional' trades, 'technical' roles and management. This recognises the reality that traditional methods will still need to be deployed.

New build opens up an additional opportunity to increase productivity. Here, the industry could make greater use of the Design for Manufacturing and Assembly (DFMA) methodologies which have been in use in Northern Europe and other countries for many decades. The DFMA approach is based upon maximising the proportion of a building or infrastructure asset that is made in a controlled manufacturing environment and hence reducing the time on-site. Some of the recorded benefits of DFMA are:

- Major reduction in lapse time on-site (50-60%), reducing the impact of inclement weather and other site-based risks;
- 60% reduction in time 'person hours' on site with 65-70% DFMA component. This helps address the shortages in traditional skills, although it does mean we need a new higher level of 'assembly technician';
- Improvements in quality as well as energy conservation as a result of controlled manufacturing techniques, building information modelling (BIM), computer aided design (CAD), drones (UAV) (LIDAR), robots, virtual reality (VR/AR) and Artificial Intelligence (AI);
- 30% reduction in overall time from inception to completion;
- Reduction in overall risk as a result of less environmental uncertainties, bringing more control to timescales and costs; and
- Creation of more highly technical and well-paid off-site manufacturing jobs, which will help to address some of the industry's skills shortage and image problems.

At this early stage in development, we are not necessarily seeing major cost savings, but these will come in the future, arising from the economies of scale, if there is a higher proportion of DFMA in all construction new build projects.

To gain maximum benefit from these productivity opportunities will mean upgrading the skills of the existing workforce and new entrants, as well as the people who will be training them and assessing their competencies. We are aiming for a better trained workforce which gets more things right first time. To get there we will need tutors and assessors that can use the new tools, equipment, materials and methods themselves as well as understand DFMA so that they are confident to teach and assess.

The move to new digital tools/equipment, materials, and related methods, requires investment by individual businesses with the industry, investment by Government as one of the major clients for infrastructure, and the investment by Government in Further Education spending to drive future improvements. The Further Education sector considers that Government investment has declined over the last 10 years which has impacted progress on skills development. Prior to the announcement of the upcoming General Election, there had been encouraging Government announcements indicating that there were plans to correct this.

CITB's publication "*Unlocking Construction's Digital Future*" (2018) provides the framework for progressing digitisation, for example:

- Six digital leadership projects funded by CITB (£1.2m);
- Funding work on a digital competence framework (£800k); and
- Digital training to be commissioned.

DFMA is a harder mould to break. We are still slow to make the move and it is still not mainstream in the UK as it is in some other countries. In 2018 it is reported that only 1% of new housing was completed using DFMA

methods. That is not to say that the industry is not aiming to move this forward e.g. Laing O'Rourke and Balfour Beatty are investing in DFMA, CITB is investing in an off-site manufacturing project with the Manufacturing Technology Centre, the Hub approach of Heathrow and Dudley College's investment in the Advance Facility in the West Midlands and in future North London. However, so far, we have seen limited progress in terms of overall impact. Much more needs to be done on the ground. We have not won all the hearts and minds across the sector, but CITB evidence suggests companies are open to change in the coming years.

The industry understands the need for change and the challenges associated with this. It also recognises that the historic fragmentation of the sector, as recorded in the Government Construction Strategy 2016, is one of the factors holding back improvement. However, there is optimism amongst employers that this will change due to the establishment of the CLC and the agreement with the Government on the Sector Deal.

CLC has a plan to deliver its vision of the "Future of the Industry" and the "*Future Skills Report*" which sets out the direction for skills. In order to fully deploy "SMART Construction" the industry concluded that it needs the:

- Development of more widespread digital skills, coupled with 'digital leadership' throughout the entire supply chain;
- Increase in technical skills, particularly important for DFMA which is a complete mind set change from commissioning, through design into construction;
- Development of collaborative skills, enabling people to work across teams and disciplines; and
- Enhancing traditional skills, as mentioned above, particularly for maintenance as well as parts of new build.

The industry appreciates that improvements are held back by market failures including:

- Tight margins which do not generate sufficient funds for investment;
- High levels of sub-contracted personnel;
- Short-termism driven by volatility in demand and confidence, as well as the tight margins;
- Conservatism and risk adversity by funders e.g. banks and building societies, insurers, regulators and clients/commissioners; and
- Gaps in training and workforce development, which has been exacerbated by the decline in Further Education and adult skills expenditure in the last 10 years.

For these reasons, the CLC has called for:

- Clients to agree to a code of employment in tenders which encourages the industry to increase direct employment and training;
- Creation of an environment where "SMART Construction", including DFMA, is encouraged through the early stages of design and procurement; and
- Industry qualifications and training content to be updated to include "SMART Construction" techniques and behaviours, with funding made available to accelerate adoption.

Within this context, our study has aimed to go down a level as well as bring in the learning and experiences from other countries. This has helped us to frame the recommendations later in this paper.

In saying this, we are cognisant that many of the recommendations we make later are applicable to sectors other than just construction.

REVIEW METHOD

Our qualitative approach was divided into a number of inter-linked work-streams:

- Research on productivity in construction which is outlined in the previous section;
- Survey of employers, the results of which are shown opposite, identifyng key issues for us to consider. These are in accord with what is being said in the CLC report[2];
- Observations from the WorldSkills competition in Kazan, Russia, during the latter part of August 2019. This included the various conference sessions by major international organisations involved in skills (see Annex A);
- Meetings with employers and skills development organisations from several different countries including Australia, Denmark, France, Hong Kong, Nigeria, Germany, Russia, Sweden and Wales;
- Meetings with the WorldSkills UK Training Managers and Assessors (those that decide the scores resulting in who gets medals); and
- An analysis workshop to assess the learning and recommendations.

2. *"Future Skills Report"* Construction Leadership Council, June 2019

Employers' feedback: key issues for the construction industry

- Mixed experience of 'work readiness' of young people
- Technical skills of young people at best good but many poor
- Strong commitment to apprenticeship model
- Skills that are important:
  - problem solving, good work ethic, adaptability, dedication and time keeping
  - carpentry, plumbing, digital, supervision, defect prevention, and off site/ modular construction
- Productivity held back by insufficient use of off-site manufacturing techniques, inadequate training in use of new methods and materials, low levels of employability skills, and low levels of 'site readiness'.

At this stage, it is worthwhile explaining what WorldSkills is for those who do not know, and why it was important to involve the organisation in the research process.

WorldSkills is a movement of change which came into being in 1946. The organisation exists to change the lives of young people through skills. Its 82 member organisations reach two-thirds of the world's population and create measurable impact at every level. WorldSkills builds the confidence of millions of young people, empowering communities and fuelling economies.

Key to this has been the WorldSkills competitions which started in 1950 at Madrid. This was a modest event by today's standards, but an international movement was born. The global competition now occurs every two years with separate 'feeder' events in Europe and the UK.

Young people compete against each other in very practical skills such as bricklaying, carpentry, plastering, painting etc. They are judged against an agreed international standard[3] for each trade or occupation, aimed at driving up standards. The winners receive Gold, Silver and Bronze medals. Those that don't receive a medal but demonstrate a high standard receive a medallion for excellence.

There are training managers in each country who support the competitors in their preparation for the competition. The training managers as a collective also form the cohort of judges scoring each competitor. As a result, the training managers hold a considerable amount of knowledge on what is 'good', demonstrating high standards and productivity

At the 2019 competition in Kazan, Russia, there were 1,350 competitors from 63 countries competing in six key sector areas.

WorldSkills UK competed for 13 different construction trades reflecting all the main occupations. We did not compete for concrete formwork and welding. In respect of the concrete formwork competition it utilises the highly efficient standard international walling system, which is not used in the UK. Whilst appreciating that the structure of the UK's industry property supply structure means we cannot compete, it is never-the-less concerning we cannot take part as this is a key example of "SMART Construction" techniques.

UK Competitors in Construction Skills

- Architectural stonemasonry
- Bricklaying
- Cabinet Making
- Carpentry
- Construction metal work
- Electrical installations
- Joinery
- Landscape Gardening
- Painting & Decorating
- Plastering & Drywalling
- Plumbing & Heating/WSJ
- Refrigeration & Air Con
- Wall & Floor tiling

3. This is in effect an international occupational standard of mastery at the trade

KEY FINDINGS

Construction is facing similar issues across the globe.

The industry in all the countries we met were facing similar issues:

- Challenge of digital/AI Fourth Industrial Revolution;
- Skills shortages including technical roles in the construction workforce;
- Difficulty in recruiting and retaining tutors and assessors;
- Levels of literacy and numeracy; and
- Motivational challenges to recruitment for people coming in to the industry. It is not seen as an attractive sector to work in for many countries.

However, countries such as those in Northern Europe and Hong Kong are already addressing these areas and are reporting that they are in a much better position than the UK to make changes in short timescales. This includes the societal shift from valuing knowledge to valuing delivery skills.

If the construction sector globally, wants to attract a workforce in the future, it needs to understand the current and future societal view, which has changed from a 'live to work' viewpoint to a 'work to live' ethos. The relative affluence and societal support across so many countries, means that many individuals are not driven by wealth or success and are very happy at a low aspiration point, 'ticking along'. This loss of motivation is seen as a real issue for future productivity, industries and nations. Construction globally needs to understand what motivates individuals and use this to attract workers. There is much that can be done in construction such as 'gamification' in training and use of digital equipment, 'I built that' campaigns, links to artisan and heritage skills, flexible working and the generation of 'low stress' creative jobs. Construction has to totally revitalise its image globally. It is still seen by many as 'you cannot get a good job so you will have to go into construction'.

Despite the fact that there have been enormous improvements and many very well-paid jobs, the old image of the UK construction sector still remains in many people's minds as being wet, dirty, hire n' fire, not secure and, lacking in diversity.

In terms of funding for skills training, assessment and accreditation there are a wide range of models. We therefore decided to reflect on whether other countries faced funding gaps, as in the UK, regardless of their individual funding mechanisms. Interestingly, countries did not raise lack of funding for skills as an issue affecting their ability to train a productive construction workforce.

Structure of the workforce varies between countries

Those countries that are more successful at skill development generally have a higher proportion of directly employed people in the workforce which makes training and upskilling easier to achieve.

There is another aspect which differs from UK practice and that is the craft trade structure. All countries in Northern Europe recognise that there are two distinct types of craftsperson. The first is a craftsperson with standard skills who is employed on high volume repetitive activities and has excellent dexterity and hand skills; this will be a large proportion of the craft workforce.

The second is the master craftsperson who does the more difficult highly skilled activities requiring a higher level of academic attainment in subjects such as English and Maths; generally there will only be a demand for a smaller number of these.

In the UK, we try to merge these into one type of craft skill meaning that we do not properly satisfy the differing requirements of a) fast, highly productive repetitive working and b) high skilled, high quality output. Training can 'drive' individuals to the higher level before they are sufficiently competent. Instead individuals should go back to training after a number of years in the job to gain the remaining master craftsperson skillset.

We found that that in many Northern European and some other countries there was a greater use of off-site manufacturing, resulting in a workforce of well-paid assembly technicians and manufacturing technicians. All countries still saw the need for traditional skills as it is not a choice between manufacturing and traditional build. There is a blend, but with off-site being more mainstream than in the UK.

UK construction skills are sliding backwards at international competition level

Evidence from the medal tables and the observations during the WorldSkills competition is that the UK construction competitors are steadily falling behind other countries. We can see this in the medal table below. It is interesting to see that the decline in medals for the UK mirrors the timescale for the perceived Government cuts in funding to Further Education and adult skills.

UK construction track record

Medal	2011	2013	2015	2017	2019
Gold	**3**	**2**	**2**	**0**	**0**
Silver	**1**	**1**	**2**	**1**	**0**
Bronze	**3**	**1**	**1**	**2**	**0**
Medallion of Excellence	**3**	**7**	**6**	**4**	**7**
Totals	**10**	**11**	**11**	**7**	**7**

The profile of medals over the last eight years is an indicator of the type of challenge there can be in training the workforce to match the needs of the future; in the context of having adequate funding available for this investment.

Our use of modern digital tools and productive working practices is not as good as the best globally, although there are other factors which would affect this such as the amount of time to prepare for the competition, length of training and funding. A desire in the UK to cover all traditional skills should not reduce the time devoted to teaching modern skills and methods, as we all recognise the need to continuously upgrade our training, including that for "SMART Construction" and digital techniques.

Excellence in competitions is different from the average standard of a nation's workforce in a trade. However, we clearly heard the value of the 'trickle-down' of higher skills and competence from the competitors to their peers in training providers and the workplace. Globally there will be competitive advantage from having a WorldSkills 'winning' industry.

If our industry is going to compete internationally for major contracts, our workforce has got to be as good as the best. The countries we can learn from are Australia, Austria, China, France, Germany, Korea, South Tyrol (Italy) and Switzerland.

Skills competitions can be used to drive up standards

Countries have differing motivations for competing at WorldSkills. Some are purely driven by medals. However, the best countries use the competition to drive up standards across their home sectors, such as Australia, Austria, China, Denmark, France, Germany, Korea, South Tyrol (Italy), Sweden and Switzerland. They make good use of feedback from the competitions using the 'trickle-down' effect.

In these countries they are able to disseminate the learning back into training and skills development for all students and apprentices.

The UK's record is mixed and, although CITB funds the domestic competitions, as a nation we do not invest in the international competition in the way others do. We do not appear to take competitions as seriously as others, which is a missed opportunity .

The other aspect which the UK does not appear to capitalise on strongly enough is bringing back and formally disseminating the knowledge gained by the training managers to other training providers who could encourage future competitors. This is particularly true in England; feedback in Wales is much better.

Ownership of skills is crucial to success

Best practice is where employers, employees and their trade union representatives 'own' the skill system and the key contributors, such as training providers, assessors as well as content and equipment suppliers, are integral to the development and operation of the system. It is interesting to note that France, where the 'ownership' has been with the Department of Education, is in the middle of a two-year reform programme to move the ownership to employers, trade unions, awarding/assessment organisations and other stakeholders.

In several countries that do well in the competition, in particular those in Northern Europe, there is a long history of successful working between employers, employees, trade unions and training providers.

The CITB and the construction Levy in the UK creates a feeling of full engagement and ownership by the industry which is not the case in other sectors where it is felt by many that sector skills are Government dominated.

Partnership

Agile TVET Systems are essential

The countries that perform well report that they have stable skills systems, referred to as technical and vocational education and training (TVET) systems. Characteristics of an excellent TVET system are:

- Stability;
- Delivery of what industry and the economy needs, in terms of demands and standards;
- Blended technical knowledge learning, work readiness, employability skills and practical on-the-job experience to develop skills and competencies through what is commonly described in northern Europe as the "dual system";
- Simple and easy to understand for all stakeholders including employers, employees, parents/guardians, careers advisers;
- Based upon easy to understand career pathways;
- Agile and responsive to match the rate of continuous change. This point was a stronger theme not just in the individual discussions we had, but also in the main conference speeches (see Annex A) as well; and
- Well-regulated to remove underperforming organisations in training, assessment and accreditation.

The current cycle of UK skills reform, which started in 2013 with Trailblazers Phase 1, has still not established a completely functioning TVET system[4]. One of the areas which we particularly note was the inability to be 'agile', a point brought up by many speakers at the conference.

As an example, we noted the experience in Hong Kong. Like the UK they have over 150 different occupations. Their employer-led TVET system was able to upgrade the teaching curriculum in less than 12 months across all occupations/trades. Whilst appreciating that Hong Kong is a smaller country and therefore change can be easier to manage; the UK system, with Trailblazers, T-Levels and other vocational qualifications, after six years of reform is no-where near being able to upgrade a whole sector in a year. However, technology is changing every six months. We need to fundamentally rethink the way our system works and how we maintain it.

Use of digital/AI/manufacturing tools and techniques

UK construction in its current form is mainly an onsite based industry, requiring a transient workforce, employed for time-based periods depending on the size of the contract, driving self-employment, sub-contracting and short contracts. This is not the way to attract and retain highly skilled motivated individuals. Construction needs to continue to develop its delivery model, including greater proportion of off-site manufacturing; bringing with it the advantages of speed, accuracy and automation. Individuals are more likely to take a job if they know they can travel to the same place for a substantial period of time compared to one where they need to be transient.

The greater use of factory produced components will assist with the skills issue in the industry, increase productivity, reduce construction issues and increase client satisfaction. This will consequently bring further benefits of promoting the use of artificial intelligence in the development, design and manufacture of components. There are significant logistical issues with the transportability of large and heavy units, however, this is already being addressed successfully. This revolution needs to start with the client and design individuals pushing the industry to change how it goes about fulfilling its orders. If this does not happen then the productivity and future technology benefits will not be realised, and substantial projects will not be built, due to a lack of a workforce to deliver them, regardless of how much money is thrown at them.

Where traditional skills are required, including in maintenance activities there is also a need to use digital technologies, modern materials and digital tools.

Investment and innovation

Those countries that are best placed to face the challenges are able to invest in new ways of working and training. Other countries appear to have financial institutions, insurers and regulators that are more willing to allow, specify and fund innovation. Sweden was a case in point where funders were reported to be more likely to invest if there was innovation in the project rather than traditional methods.

4. *Close the Gap*, C&G and NOCN, September 2019

Regulatory frameworks

Whilst recognising that not everything can be achieved through off-site techniques; some of the best performing countries have a more advanced use of off-site manufacturing techniques within house building and infrastructure. It is more 'mainstream' as opposed to the UK where it is still on the periphery.

Best practice is in countries where off-site manufacturing is embedded in commissioning and design, unlike in the UK where there is more focus on how you build rather than how you design. The UK's narrow approach severely limits the benefits for off-site techniques.

Some countries are driving the move to more off-site construction by regulation and government procurement e.g. Singapore where all high-rise buildings must be constructed with at least a 60% proportion of off-site components. This has resulted in an overall increase in off-site manufacturing.

The Government recognises the clear direction of travel with a presumption in favour of the move to a higher proportion of off-site manufacturing. This move is being supported by the work of CITB.

Training and skills development for tutors and assessors

All countries recognised the challenge faced by upskilling the tutors and assessors in the new digital techniques and tools. There is also a common challenge in recruitment of tutors and assessors as people are able to earn significantly more working 'on-the-job'.

Many are already making progress and have established approaches in place; whilst the UK has for nearly 10 years cut back investment on the capacity building of the further education sector.

The best practice internationally in training and skills, of teaching and assessing staff, includes:

- National curriculum standards set with employers and other key stakeholders, these include off-site techniques;
- Setting pay rates at a level that reflects industry's needs to attract staff;
- Formal and mandatory CPD for tutors and assessors to ensure that they remain up to date;
- Investment in new 'digital' equipment and tools in training establishments; and
- Investment in upskilling tutors and assessors in the new 'digital' skills.

Literacy and numeracy are important

Many countries face a varying challenge with literacy and numeracy in the recruits that wish to be trained and enter the construction sector.

The Northern European system deals with this in its 'dual system'[5], whilst others use different methods. However, we picked up on a pragmatism which recognised that 'hand skills' were more important in some roles than literacy and numeracy and that a balanced view rather than a centrally driven level, applied to all industries was better. It is clear that 'practical' individuals are attracted to construction and they should not be put off by unnecessary academic barriers.

5. https://www.bmbf.de/en/the-german-vocational-training-system-2129.html

RECOMMENDATIONS

We set out a range of recommendations for employers, government and training providers, which are listed separately, but in reality, are inter-related and need to be viewed as a whole.

Employers

- Commit to increasing productivity and hence invest in new digital equipment and off-site techniques (SMART construction);
- Invest in a high-quality upskilling of the workforce, utilising the CITB and other Levies to their maximum benefit, as well as make focused use of short accredited courses;
- Continue to support reputable training providers and awarding/assessing bodies, in conjunction with CITB, to understand the changing needs of the sector and how they can adapt to support the industry;
- Support a communications programme, through the CLC and CITB to address the motivational challenge which is restricting recruitment, stressing the considerable benefits of a career in construction;
- Revise the craft structure to craftsperson and master craftsperson, whilst being careful not to reduce the required skill levels of the craftsperson;
- Move to a higher proportion of directly employed personnel;
- Increase the numbers of apprentices entered into skills competitions, to build a stronger workforce and bring more international learnings back into UK industry;
- Continue the work to develop the requirements for apprenticeship standards and qualifications needed to support the move to a higher proportion of off-site manufacturing and digital skills; and
- Increase the focus on continuous professional development in the industry so it becomes the norm to gain increasing and new skills and capabilities throughout a career, not just the mandatory refresher courses.

Government

- As a client for major projects encourage the specification of off-site techniques and embed these in the commissioning and design phases;
- As a regulatory and planning authority to stipulate standards, such as those in Singapore, to require developers to use more sustainable and SMART construction techniques;
- Through CITB, work with employers on a campaign to address the motivational challenges of recruitment in the sector, including a more pragmatic approach to literacy and numeracy funded by Government education expenditure;
- Introduce a TVET system which embodies the international best practice features such as employer, employee, trade union and stakeholder ownership, agility, simplicity and easy career pathways, whilst retaining the current building blocks which are well understood and embedded;
- As the regulator for skills standards, through the Department for Education and the Institute for Apprenticeships and Technical Education, revise the curriculum, ideally for 2020, of the Construction Design, Surveying & Planning T-Level to include commissioning and design based on DFMA off-site techniques (SMART construction);
- As the funder for skills through the Department of Education, increase funding rates to ensure that training providers are able to invest in both digital equipment/tools and capacity building for tutors, assessors and others on digital skills (SMART construction methods);
- Invest, through the Department of Education, to embed mainstream skills competitions throughout as a mechanism for increasing skills to drive them towards international standards, such as those used in WorldSkills; and
- Ensure that the regulators of both training organisations, awarding organisations and end-point assessment organisations take tangible steps to increase the standard of their delivery, removing poorly delivering organisations.

Training Providers

- Continue to work closely with employers and other stakeholders to support their rapidly changing needs for apprenticeships, technical qualifications and upskilling;
- Invest in new digital and off-site equipment and tools to support the teaching of SMART construction techniques;
- Invest in upskilling curriculum managers, tutors, assessors and other key staff on new digital and off-site equipment and tools to support the teaching of SMART construction techniques;
- Introduce formal mandatory CPD for all tutors and assessors and other key staff;
- Use the British Association of Construction Heads as the vehicle in construction for formally feeding back and disseminating the learning from national and international skills competitions;
- Work with Government and employers on campaigns to address the motivational challenges of recruitment into construction; and
- Increase the numbers of apprentices entered into skills competitions to improve the provision of the skills through the competitive benchmarking.

Clearly, we need to improve in the areas above so that more employers feel 'ownership' and the other stakeholders such as employees, trade unions, training providers, awarding and assessment bodies, IT and equipment suppliers feel better involved. This will then help to give parents, guardians and young people more confidence to enter the construction industry and develop a potentially rewarding and exciting career.

Annex A: International Conference Speeches at WorldSkills 2019

Risk-engineering as the new norm – for this and the next generation

- Nassim Nicholas Taleb, Former Trader, Risk Specialist, and Author

A world at risk: developing the skill sets to endure, adapt, and thrive

- Tatyana Golikova, Deputy Prime Minister of Russia for Social Policy, Russia; Chairman of the 45th WorldSkills Competition Organizing Committee
- Heinz Koller, Regional Director, Regional Office for Europe and Central Asia, ILO
- Nassim Nicholas Taleb, Former Trader, Risk Specialist, and Author
- Amelia Addis, Regional Representative for ASEAN and Oceania, WorldSkills Champions Trust
- David Hoey, CEO, WorldSkills International
- Jaime Saavedra, Global Director, Education, World Bank

Continuous agile learning

- Danny Gauch, Director General, Worlddidac Association Switzerland

Different place, same skills – timely transnational cooperation

- Jens Bjornavold, Senior Expert, Cedefop
- Cesare Onestini, Director, European Training Foundation
- Manuela Geleng, Director for Skills, European Commission
- Monica Pfarr, Executive Director, AWS Foundation, American Welding Society, USA
- San-Quei Lin, WSI Vice President for Special Affairs and Vice Minister of Labour, Chinese Taipei

The future of work through the prism of youth

- Neil Bentley-Gockmann, CEO, WorldSkills UK
- Laurence Gates, Board Member, WorldSkills International
- Jacqueline Tanzer, Regional Representative for Europe, WorldSkills Champions Trust
- Gary Condon, Regional Representative for Middle East and North Africa, WorldSkills Champions Trust
- Shayne Maclachlan, Communications Campaigns Manager, OECD
- Nick Chambers, CEO, Education and Employers, UK

Catching the digital skills wave (before it's too late)

- Maxim Voloshin, CEO, Codewards
- Srinivas Reddy, Branch Chief, International Labour Organization
- Carla De Bona, UX Designer and Co-Founder, {reprograma}, Brazil
- Mailis Reps, Minister of Education, Republic of Estonia

What are green skills? Making sense of the green economy

- Enrico Rühle, Member of the Board, Festo Didactic SE
- Olga Strietska-Ilina, Senior Skills & Employability Specialist, International Labour Organization
- Denise Amyot, President and CEO, Colleges and Institutes Canada (CICan), UNEVOC
- Buti Manamela, Deputy Minister of Higher Education and Training, Republic of South Africa
- Boris Arseev, Deputy Director of Global Business Development, Rosatom

Making work meaningful

- Abigail Fulton, Vice President, Skills Canada BC, Executive Director of the Construction Foundation of BC
- Monica Pfarr, Executive Director, AWS Foundation, American Welding Society, USA
- Amelia Addis, Regional Representative for ASEAN and Oceania, WorldSkills Champions Trust
- Anna Prokopenia, Regional representative for Europe, WorldSkills Champions Trust

Training and innovation: a how-to guide

- Jayshree Seth, Corporate Scientist and Chief Science Advocate, 3M

Training for tomorrow: Innovations for lifelong learning

- Carl Frey, Oxford Martin Programme on Technology and Employment, Oxford
- Paul Comyn, Senior Skills & Employability Specialist, International Labour Organization
- Marion Plant, Chief Executive, Midland Academies Trust UK

Greening your workforce

- Nader Imani, Executive Vice President Global Education, Festo Didactic SE

Our planet in 2050: young people's aspirations for an aware and responsible society

- Kehkashan Basu, Founder, Green Hope Foundation
- Anna Du, 3M-Discovery Young Scientist
- Anastasia Fedosova, Engineer and inventor of galvanic waste disposal technology
- András Volom, Founder and President, V4SDG
- Nawal Allaoui, CEO, Founder, SEASKIN, Morocco and BeChangeMaker 2019 finalist

The final frontier: skills lessons from the stars

- Sergei Krikalev, Cosmonaut and executive director, Roscosmos State Corporation
- Scott Kelly, NASA astronaut

No women? No success for the 4IR

- Neil Bentley-Gockmann, CEO, WorldSkills UK
- Amelia Addis, Regional Representative for ASEAN and Oceania, WorldSkills Champions Trust
- Jayshree Seth, Corporate Scientist and Chief Science Advocate, 3M
- Kathleen Elsig, Head of Strategic Partnerships and Development, The Global Apprenticeship Network GAN

Designing skills pathways for local challenges

- Kelly Betts, Skills Canada BC, Former President
- Norbert Schoebel, Team Leader, European Commission
- Bruce Poh, CEO, ITE Education Services Singapore
- Abdelaziz Jaouani, Senior Expert, European Training Foundation

TVET systems for 2030

- Manuela Geleng, Director for Skills, European Commission
- Tatyana Terentyeva, Chief Human Resources Officer, Rosatom
- Anton Stepanenko, Partner, BCG Russia
- Borhene Chakroun, Director, UNESCO Division for Policies and Lifelong Learning Systems
- Alexandria Valerio, Lead Education Specialist, The World Bank
- Ekaterina Loshkareva, Moderator, Official Delegate, R&D Director, WorldSkills Russia

From small seeds: growing skills for sustainable agriculture

- Mwila Kangwa, CEO, AgriPredict
- John Halligan, Minister of State for Training and Skills, Republic of Ireland
- Oleg Stepanov, DG and Co-Founder, LavkaLavka

Education ecosystem for the future economy

- Jan Owen, CEO, Foundation for Young Australians
- Vishal Talreja, Co-Founder and Trustee, Dream a Dream, India

Five inspirational stories that demonstrate that skills change lives

- Abigail Fulton, Vice President, Skills Canada BC, Executive Director of the Construction Foundation of BC
- Mursal Hedayat, CEO, Chatterbox
- Salinee Hurley, Founder-CEO, Sun Sawang Co.
- Tijhimise Bruno Karaerua, Regional Representative for Africa, WorldSkills Champions Trust
- Alexey Fedoseev, President, Kruzhok Association

Who's driving? How to design and lead TVET systems

- Sue Husband, Director of Employer and Employee Engagement, Education and Skills Funding Agency UK
- Jefferson Azevedo, Coordinator of International Affairs, Conif, Brazil

Create your path: entrepreneurship education to boost skilled people

- Anastasia Fetsi, Head of Operations Department, European Training Foundation
- Mikko Sallinen, Head of Learning Experience, Omnia Education Partnerships Ltd Finland
- Maxim Kiselev, CEO, ANO Human Capital Development
- Saje Molato, CEO and Founder, Siklab, Philippines and BeChangeMaker 2019 finalist
- Manish Kumar, Managing Director, CEO, National Skill Development Corporation India

Cooperation practices to train agile skilled young people

- Kathleen Elsig, Head of Strategic Partnerships and Development, The Global Apprenticeship Network GAN
- Norbert Schoebel, Team Leader, European Commission
- Ranjan Choudhury, Sr. Head, WorldSkills India

Developing the next generation of skilled changemakers

- Jos de Goey, President Elect, WorldSkills International
- Dmitry Peskov, Special Representative of the President of the Russian Federation on Digital and Technological Development
- Sarah Anyang Agbor, Commissioner, Human Resources, Science and Technology, African Union
- Tang Tao, Vice Minister of Human Resources and Social Security, People's Republic of China
- Chirag Goel, Regional Representative for Asia, WorldSkills Champions Trust
- Borhene Chakroun, Director, UNESCO Division for Policies and Lifelong Learning Systems

Annex B: **Results from WorldSkills Kazan 2019**

The UK was not in the top ten of countries for medals[6].

Overall Ranking

1. China
2. Russia
3. Korea
4. Chinese Taipei
5. Brazil
6. Switzerland
7. Austria
8. Japan
9. France
10. Singapore

6. UK have been 12th in the top 10 for the last 10 years

For construction the results were:

Skill	Gold	Silver	Bronze	UK
Architectural stonemasonary	China	Austria France	–	–
Wall & Floor tiling	Germany Switzerland	Russia Brazil	–	MoE
Plumbing & Heating/WSJ	Korea	China	Australia Switzerland	MoE
Electrical Installations	China	Chinese Taipei	Brazil South Tyrol (Italy)	MoE
Bricklaying	China	Austria	South Tyrol (Italy)	MoE
Plastering & Drywalling	Russia	China	France Switzerland	MoE
Painting & Decorating	Austria	Switzerland	France	MoE
Cabinetmaking	Hungary	Switzerland China	–	–
Joinery	France	Korea	Switzerland Austria	MoE
Carpentry	Germany	Korea	Switzerland South Tyrol (Italy) France	–
Landscape gardening	Switzerland	South Tyrol (Italy)	Colombia	MoE
Refrigeration & Air Con	Russia Korea	Australia	–	MoE
Construction metal work	Korea	China Austria	–	–
Concrete Formwork	China Austria	–	Germany	–
Welding	China Russia	–	Brazil Japan Korea	–

MoE – Medallion of Excellence

NOCN Group

NOCN Group is an educational and skills charity whose core aim is to help learners reach their potential and organisations thrive. The group includes business units specialising in regulated UK and international qualifications, End Point Assessment, Access to Higher Education, assured short courses, SMART job cards, assessment services, consultancy, and research.

NOCN is at the forefront of vocational skills development and apprenticeships, including the introduction of the Apprenticeship Levy in the UK. NOCN is the only awarding body in the UK which specialises in productivity and is focussed on increasing the UK's competitiveness globally. We are one of the UK's largest awarding organisations in the construction sector, and we are committed to working for a better future for UK construction skills, via our sub-brands Cskills Awards and CPCS (Job Cards).

WorldSkills UK

What we do: We are an accelerator for young people in the start-up phase of their careers. This means we inspire more young people to take up apprenticeships and technical education; we champion their success; and we accelerate their personal and professional development.

Why we do it: To change the national conversation so that apprenticeships and technical education are seen as prestigious career routes for all young people.

How we do it: Through experimental and digital career advice; skills competitions, and mindset and productivity training.

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