



# WorldSkills Approaches to Comparable Skills Assessment in Vocational Education

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WorldSkills Approaches to Comparable Skills Assessment in Vocational Education / Dudyrev, F., Froumin, I., Maltseva, V., Loshkareva, E. and E. Tatarenko ; National Research University Higher School of Economics, Institute of Education; WorldSkills Russia. Moscow: HSE, 2019. — 44 pp. — Sovremennaja analitika obrazovanija [Modern Analytics of Education], No 8 (30).

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Our sincere thanks go to Inna Chernoskutova, Dmitry Peskov, Irina Potekhina, Peter Schedrovitsky, and Robert Urazov for their insights and valuable comments.



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КОИКУ

ПСАИТ



# Introduction

TVET institutions around the globe are responsible for providing youths and adults with relevant skills for employment and developing career paths<sup>1</sup>. Vocational education and training cultivates human capital, promotes inclusive and sustainable economic growth and full and productive employment.

Technical skills are the cornerstone of a worker's profile and human capital capability. But TVET systems should also help to develop and master transferable (both cognitive and non-cognitive) and digital skills for tomorrow's jobs. This set of transferable technical skills will shape the success of young people in the VUCA world.

Skills assessment is a key issue on the post-secondary education agenda. Developing valid assessment methodologies appears to be challenging both intellectually and politically. There are very few cases of effective assessments of TVET learning outcomes implemented at the national level. Cross-country assessments are even more challenging. The OECD project AHELO (Assessment of Learning Outcomes in Higher Education)<sup>2</sup> is an attempt to assess educational outcomes among bachelor degree graduates across countries. The implementation of the AHELO study has uncovered methodological problems inherent in cross-national research especially when assessing high-

level cognitive skills and at the post-secondary level. The same challenges of cross-national assessment were faced in projects dealing with vocational education. PISA-VET<sup>3</sup>, a project for large-scale assessment in eight European Union member states, was an attempt to develop a cross-country assessment of TVET student learning outcomes, yet this assessment was never implemented.

The WorldSkills movement is an initiative that successfully addresses global challenges of skills development and assessment. WorldSkills member organizations are present in 82 countries, including all G20 states, and cover more than two-thirds of the world's population. WorldSkills has become a global actor in the field of skills excellence and assessment that

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<sup>1</sup> United Nations (2015) Transforming our World: the 2030 Agenda for Sustainable Development.

<sup>2</sup> AHELO Main Study. OECD supports the assessment of learning outcomes in higher education. <http://www.oecd.org/education/skills-beyond-school/ahelo-main-study.htm>

<sup>3</sup> Baethge M., Achtenhagen F., Arends L., Babic E., Baethge-Kinsky V., Weber S. (2006) PISA-VET. Feasibility Study. Franz Steiner Verlag.

shapes and drives the policy of national TVET systems for building the framework of skills development and assessment.

This publication aims at producing recommendations on improving skills assessments of vocational students and graduates by embedding WorldSkills standards. These recommendations bring together the experience of national TVET sectors that employ WorldSkills best practices in skills development and especially objective skills assessment.

This report covers the following key topics:

- How does rapid technological change transform the demand for skills development and assessment?
- What well-established and emerging approaches to skills and qualification assessment are used across different countries with both advanced and emerging economies?
- What are the prospects of the WorldSkills methodology for the objective assessment of learning outcomes in TVET?
- What are the prospects of using the results of skills competitions based on WorldSkills standards as a valid measure of the quality of vocational education at the international, national and sub-national levels?
- What is the institutional design of a skills assessment system that ensures the relevant and comparable measurement of the skills of youth entering labor markets (including TVET graduates)?

This report was drafted by the National Research University Higher School of Economics at the initiative of the Union “WorldSkills Russia” in partnership with representatives of the WorldSkills movement in Australia, the Netherlands and the United Kingdom.

We hope this paper shall contribute to the discussion of skills development and objective skills assessment in TVET and promote the dissemination of WorldSkills practices for building international comparative skills assessments in TVET.







# 1



## TVET systems facing skills agenda challenges

### 1.1 Labor market trends shaping global skills agenda

National TVET systems are facing challenges driven by global socio-economic transformation and rapid technological change. We list below the key challenges resulting from disruptive technological innovations that are currently shaping labor market transformations and guiding demand for new roles and skills of youth and adults.

- **Dramatic increase in the demand for new roles with a decreasing demand for traditional ones**

The global labor market is driven by the two opposite trends. On the one hand, human employment in traditional industries is rapidly being replaced by machine labor due to automation. In 2018, an average of 71% of total task hours across 12 industries was performed by humans, compared to 29% by machines. By 2022, this average is expected to shift to 58%

and 42%, respectively<sup>4</sup>. On the other hand, new industries, jobs and roles are emerging as a result of technological innovations and the new division of labor. At the same time, other socio-economic transformations (internationalization of supply chains, increasing urbanization, growing middle class in emerging economies, population ageing, promotion of the green economy and sustainable development) are also contributing to the dramatic changes in global employment.<sup>5</sup>

The key point is that the aggregate demand for labor is increasing, yet this is a demand for new roles and new skills. It is estimated that technological changes that replace routine work have created over 23 million jobs across Europe from 1999 to 2016, or almost half of the total increase in employment over the same period<sup>6</sup>. According to the World Economic Forum, 75 million jobs have been displaced by a shift

in the division of labor between humans and machines, with the emergence of 133 million new roles that are more adapted to the new division of labor between humans, machines and algorithms<sup>7</sup>. The emerging roles in demand mostly represent jobs of the digital economy: data analysts and scientists, software and applications developers, and ecommerce and social media specialists. Moreover, there is an accelerating demand for a variety of brandnew roles related to deploying the latest emerging technologies: AI and machine learning specialists, big data specialists, information security analysts, and robotics engineers.

- **Job polarization and a decrease of middle-skill jobs**

Technological change is transforming the content and skill profiles of existing jobs in the sense that it increases the relative demand for non-routine tasks and decreases demand for routine roles. Therefore, skilled workers performing non-routine tasks benefit from technological change. This group includes not only high-skilled workers that benefit from the growing number of jobs and wage levels but also middle-skilled workers performing non-routine tasks. Skilled workers performing routine tasks represent the most vulnerable group of workers in the face of labor-replacing automation. Unskilled and low-skilled jobs involving non-routine manual and cognitive

tasks that have resisted automation so far (childcare, etc.) are less vulnerable in the face of automation. However, these workers can suffer from falling wages as the replaced middle-skilled routine workers may enter these jobs instead<sup>8</sup>. For example, middle-skilled jobs shrank by 10% in OECD countries excluding Hungary and the Czech Republic in 1995-2015<sup>9</sup>. The most highly automated industries experience more evident job polarization (e.g. manufacturing, financial services and insurance sector).

- **Increasing demand for transferable skills and new technical skills**

The role of transferable skills that shape flexibility and the ability to adapt to new working patterns and jobs is increasing in the context of rapidly changing labor markets<sup>10</sup>. Transferable or universal skills include complex problem-solving, socio-behavioral and self-regulation skills<sup>11</sup>. These transferable skills facilitate the development of continuous learning skills. The growing skills instability and the changing job profiles undermine the relevance of prior work experience and knowledge. The proportion of core skills required to perform a job is expected to be about 58%, meaning an average shift of 42% in required workforce skills over the period 2018-2022<sup>12</sup>.

Transferable skills, including advanced cognitive skills and adaptability, are equally applicable in both existing and emerging occupations. Advanced cognitive skills such as critical thinking and creativity will increase in value. Socio-behavioral skills, including leadership, initiative, emotional intelligence and communication & teamwork as well as lifelong learning skills are also increasing in demand<sup>13</sup>. According to the World Bank, the share of employment in occupations replete with non-routine cognitive and socio-behavioral skills has increased since 2001 from 19 to 23% in emerging economies and from 33 to 41% in advanced economies<sup>14</sup>.

The demand for technical skills is experiencing two trends. On the one hand, routine-based, middle-skilled roles are expected to become increasingly redundant. On the other

<sup>4</sup> WEF (2018) The Future of Jobs Report 2018. Centre for the New Economy and Society, World Economic Forum.

<sup>5</sup> Bakhshi H., Downing J., Osborne M., Schneider P. (2017) The Future of Skills: Employment in 2030. London: Pearson and Nesta.

<sup>6</sup> World Bank (2019) World Development Report 2019: The Changing Nature of Work. Washington, DC: World Bank.

<sup>7</sup> WEF (2018) The Future of Jobs Report 2018. Centre for the New Economy and Society, World Economic Forum.

<sup>8</sup> WTO (2017) World Trade Report. Trade, Technology and Jobs. Geneva: World Trade Organization.

<sup>9</sup> OECD (2018) Good Jobs for All in a Changing World of Work: The OECD Jobs Strategy, OECD Publishing, Paris.

hand, the amount of non-routine middle-skilled tasks is increasing (design of individual projects, troubleshooting). Moreover, tasks in traditional industries are becoming more technologically challenging and require high-level skills in STEM disciplines and emerging innovative sectors. In this respect, combinations of high-level technical skills and skills in emerging sectors are in the greatest demand<sup>15</sup>.

- **Changing skills requirements for job seekers and employees**

Employers agree on the significance of a skills gap problem and regard it as an obstacle to business development and economic growth. Hiring high-skilled workers with a combination of advanced technical and transferable skills is more tough than finding middle and low-skilled workers due to a lower deficit of routine technical skills<sup>16</sup>.

Employer surveys in advanced economies attest to an increasing demand for transferable skills. The top skills sought by US employers include complex problem-solving skills (83% of employers mention it), teamwork skills (83%), communication skills (80.3%) and technical skills (60%)<sup>17</sup>. Employers are less satisfied with the transferable skills of graduates, especially high cognitive and socio-behavioral skills, than with their technical skills. According to the survey of leading employers in Canada, graduates mostly meet the requirements for technical/professional skills (95.7% of companies agree with this statement), while only 73% of companies are satisfied with the level of socio-behavioral skills<sup>18</sup>. Employers in emerging economies, especially in innovative companies, also have reported a significant skill gap in the survey conducted under the World Bank STEP Skills Measurement Program<sup>19</sup>.

<sup>10</sup> World Bank (2019) World Development Report 2019: The Changing Nature of Work. Washington, DC: World Bank.

<sup>11</sup> Froumin I., Dobryakova, M., Barannikov, K., Remorenko I. (2018) Key Competences and New Literacy: From Slogans to School Reality. Preliminary results of the international report of major trends in the on-going transformation of school education. Issue 2 (19). Moscow: NRU HSE.

<sup>12</sup> WEF (2018) The Future of Jobs Report 2018. Centre for the New Economy and Society, World Economic Forum.

<sup>13</sup> Ibid.

<sup>14</sup> World Bank (2019) World Development Report 2019: The Changing Nature of Work. Washington, DC: World Bank.

<sup>15</sup> Ibid.

<sup>16</sup> World Bank (2018) Measuring skills demanded by employers: skills toward employment and productivity (STEP) (English). Jobs Notes; issue no. 5. Washington, D.C. : World Bank Group.

<sup>17</sup> NACE (2018) NACE Job Outlook 2018. National Association of Colleges and Employers.

<sup>18</sup> Business Council of Canada (2018) Navigating change: 2018 Business Council Skills Survey. Business Council of Canada, Morneau Shepell.

<sup>19</sup> The STEP Skill Measurement Program. World Bank Microdata Library. <http://microdata.worldbank.org/index.php/catalog/step/about>



## 1.2 National TVET systems tackling skills agenda challenges

The majority of existing TVET institutions were established during the industrial era and were targeted at educating workers at the basic and intermediate occupational levels for manufacturing jobs. These TVET programs are offered at three ISCED-2011<sup>20</sup> levels: upper secondary (ISCED 3), post-secondary non-tertiary (ISCED 4) and short-cycle tertiary education (ISCED 5). TVET providers range from secondary schools to universities.

Confronted by the post-industrial economy framework and increasing tertiarization, TVET schools have to rethink their strategies, promote a new image of vocational jobs and build links with industry and other stakeholders. Current and upcoming socio-economic transformations will have a huge impact on TVET national policies and strategies. These challenges to the education-employment nexus of rapid technological change are shaping national TVET agendas in countries that are promoting the development of human capital.

Below we give an overview of the key challenges facing TVET systems in Australia, the Netherlands, Russia and the United Kingdom (Boxes 1-4). These briefs are based on materials specially prepared by national experts for this report. This overview is also based on strategic and policy papers and analytical and expert reports by different national and international think-tanks, including UNESCO, OECD, World Bank, ILO, and CEDEFOP.

- **Modernizing vocational programs to meet new labor market requirements for worker skills**

The biggest challenge for the national TVET sectors covered in this report is to provide youth with up-to-date skills and ensure their readiness for future occupations. Thus, keeping up with the rapidly changing world of work and catering to the needs of employers and industry are the most acute issues across countries. This

challenge could be addressed by enhancing the engagement of industry at all the levels of the TVET system by harmonizing occupational standards (Russia) or the occupational framework (Australia) or increasing the involvement of employers in curriculum development and vocational teaching (e.g. apprenticeship programs in the Netherlands and emerging T Levels in the UK).

- **Developing vocational programs for emerging occupations**

For a long time, the TVET system has been living in a well-established framework of qualifications and jobs. Today's rapid changes in occupations and job content call for harmonizing the new qualification framework and TVET educational outcomes. Australia is a case in point of a sound match between qualifications and TVET learning outcomes<sup>21</sup>.

- **Contributing to increasing labor productivity via improved TVET provision**

Job creation is directly associated with a rise in labor productivity. However, increasing labor productivity in traditional industries remains an urgent task. In the UK TVET sector (see Box 4: "Ensuring that teaching and training in TVET helps UK industry and business to be more productive"), this challenge is tackled through the mandatory provision of digital skills training and the promotion of professional identity. The same strategic approach is relevant for Russian vocational education<sup>22</sup>. Enhancing the quality of Russian TVET can be achieved by embedding WorldSkills standards into TVET programs.

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<sup>20</sup> UNESCO (2015) International Standard Classification of Education ISCED 2011. UNESCO Institute for Statistics. <http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf>.

Box 1.

## TVET in Australia

**ISCED 2-5**

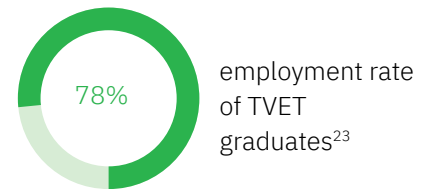
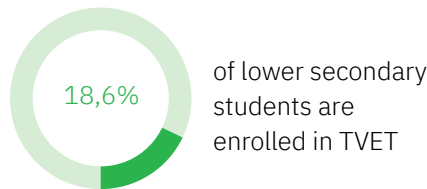
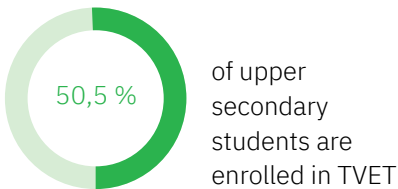
TVET programs

**4.5 million**

TVET students

**\$ 9,328**

PPP total expenditure on upper secondary TVET per student



**⚡ Challenges facing TVET in Australia:**

- Need to update training packages faster
- Improving the quality of training for tackling skills shortages
- Making TVET more attractive for school leavers and increasing completion rates in TVET
- Strengthening the role of TVET as an institution of social inclusion
- Balancing the initial training of young people with the re-training of older workers

Box 2.

## TVET in the Netherlands

**ISCED 2-5**

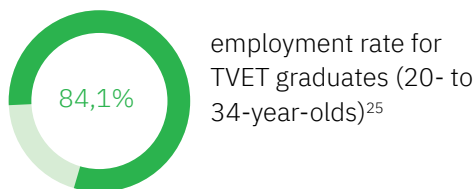
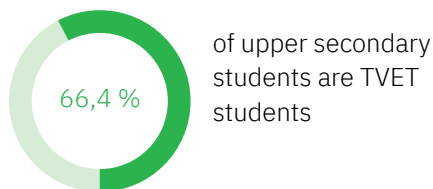
TVET programs

**0.9 million**

TVET students

**\$ 14,698**

PPP total expenditure on upper secondary TVET per student



**⚡ Challenges facing TVET in the Netherlands:**

- Ensuring access to further learning opportunities for TVET graduates
- Building continuous learning trajectories between vocational programs
- Sustaining work-based learning as the core element of the upper secondary TVET system
- Tackling the expected shortage of teachers especially in TVET
- Providing flexible postsecondary TVET programs for adults

Box 3.

## TVET in Russia

**ISCED 3-5**

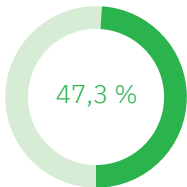
TVET programs

**2.9 million**

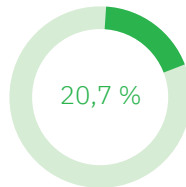
TVET students

**\$ 3,664 \$**

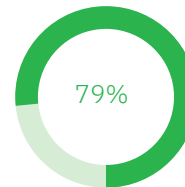
PPP total expenditure on upper secondary TVET per student



of lower secondary students are enrolled in TVET



of upper secondary students are enrolled in TVET



employment rate of TVET graduates<sup>26</sup>

**⚡ Challenges facing TVET in Russia:**

- Providing a skilled workforce for hi-tech exporting industries
- Raising the quality of vocational education by incorporating international professional standards
- Increasing capabilities for the professional development of TVET teachers and trainers
- Facilitating social inclusion by improving youth access to vocational education
- Enhancing the involvement of employers and industry to update the curriculum and initiate flexible TVET programs for adults

Box 4.

## TVET in the United Kingdom

**ISCED 3-5**

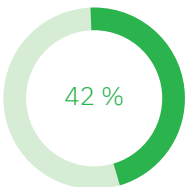
TVET programs

**2.2 million**

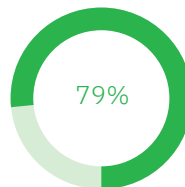
TVET students (63% of whom are adults)

**\$ 9,440 \$**

PPP total expenditure on upper secondary TVET per student



of upper secondary students (16-17-year-olds) study in FE colleges



employment rate for TVET graduates (20- to 34-year-olds)<sup>24</sup>

**⚡ Challenges facing TVET in the UK:**

- Ensuring that teaching and training in TVET helps UK industry and business to be more productive
- Tackling the skills shortage and better meeting employers' skills needs
- Maintaining close links with industry and business
- Improving the profile and esteem of TVET
- Sustaining high-quality services to learners (both young people and adults) and employers
- Improving accessibility and progression in TVET

- **Enhancing the image and attractiveness of vocational education**

To improve the attractiveness of TVET, countries implement various policies. Some countries provide vocational programs at the tertiary level (e.g. Germany, the Netherlands, Finland), while others, e.g. Russia, strive to promote TVET, including the promotion of WorldSkills competitions. Nevertheless, the urgent issue of expanding the profile and raising the esteem of TVET is not limited to the promotion of blue-collar jobs. The real challenge is to enhance TVET graduates' employability, standard of living and career prospects. This challenge is addressed by the national TVET agendas of most countries covered by the WorldSkills movement.

- **Facilitating social inclusion and mitigating poverty via TVET**

Rapid technological development and structural changes in the labor market increase the risks of unemployment, poverty and inequality. Vocational education could contribute to the mitigation of these risks. Vocational education has been facilitating social inclusion for such disadvantaged groups as vulnerable youth, migrants, refugees and people with disabilities. In the face of dramatic socio-economic trans-

formations, TVET must strengthen its role as an institution of social inclusion, an idea that is present in the TVET strategies of all four countries covered in this survey.

- **Strengthening the role of the objective assessment of learning outcomes in TVET**

In recent decades, the assessment of learning outcomes has received special attention. There are several reasons for this. First of all, these assessments could measure the efficiency of TVET spending, especially in view of ever-growing public and private expenditures on TVET in high-tech industries. Secondly, there is a growing need for valid tools for assessing and certifying qualifications in the context of increasing labor migration and mobility. Thirdly, due to the growing internationalization of business activities, companies are interested in standardized skills assessment for job applicants and employees that would ensure valid and comparable measurements. These reasons show why the issue of objective skills assessment is at the top of the list of challenges facing national TVET systems.





<sup>21</sup> Australian Qualifications Framework. Second Edition. January 2013. Australian Qualifications Framework Council. <https://www.aqf.edu.au/sites/aqf/files/aqf-2nd-edition-january-2013.pdf>

<sup>22</sup> Presidential Executive Order No. 204 dated May 7, 2018 On National Goals and Strategic Objectives of the Russian Federation through to 2024.

<sup>23</sup> UNESCO-UNEVOC (2018) TVET Country Profile. Australia. November 2018. UNESCO-UNEVOC. NCVET (2018) Total VET students and courses 2015. <https://www.voced.edu.au/content/ngv%3A73628> OECD (2018) Education at a Glance: OECD Indicators, OECD Publishing, Paris.

<sup>24</sup> CEDEFOP (2018) Developments in vocational education and training policy in 2015-17: United Kingdom (England). CEDEFOP monitoring and analysis of VET policies. OECD (2018) Education at a Glance: OECD Indicators, OECD Publishing, Paris. Abusland, T. (2019) Vocational education and training in Europe: United Kingdom. CEDEFOP ReferNet VET in Europe reports 2018.

<sup>25</sup> Fazekas M. and I. Litjens (2014) A Skills beyond School Review of the Netherlands, OECD Reviews of Vocational Education and Training, OECD Publishing. CEDEFOP (2018) Developments in vocational education and training policy in 2015-17: the Netherlands. CEDEFOP monitoring and analysis of VET policies. Smulders H., Cox A., Westerhuis A. (2016) Vocational education and training in Europe – Netherlands. CEDEFOP ReferNet VET in Europe reports. CEDEFOP (2016) Vocational education and training in the Netherlands: short description. Luxembourg: Publications Office. CEDEFOP information series. OECD (2018) Education at a Glance: OECD Indicators, OECD Publishing, Paris.

<sup>26</sup> Indicators of the TVET sector in Russia. Available at: <http://indicators.miccedu.ru/monitoring/?m=spo> OECD (2018) Education at a Glance: OECD Indicators, OECD Publishing, Paris. Dudyrev F., Romanova O., Travkin P. (2019) Employment of Vocational Graduates: Still a Slough or Already a Ford? Voprosy obrazovaniya / Educational Studies Moscow, no.1, pp. 109-136.



# 2

## Skills assessment in TVET facing new challenges

### 2.1. Assessing technical skills: diversity of measurement tools and patterns

Qualification assessment and recognition has become increasingly significant in the knowledge-based economy. Qualification examination is the key tool in assessing skills. Tasks for exams are developed based on occupational standards and descriptions of workplace functions and related workplace competencies. Qualification requirements established in occupational standards are typically linked to national qualification frameworks. Qualification assessments have various institutional designs (or models) depending on the country's labor market and level of technological advancement. Below is a comparative overview of such models in different countries.

- In Ireland, Germany and Finland qualification assessment is conducted after graduation. The assessment is carried out by industry experts (not TVET institutions), and

assessment tools and tasks for the examination are also produced by employers and experts. For instance, the content of the assessment in Germany is developed by Chambers of Crafts and Trades, and Chambers of Commerce and Industry, which also award qualifications. Qualification examination is typically combined with the final certification.

- In other countries such as the United Kingdom, Australia, and the United States, independent credentialing organizations are responsible for qualification assessment and certification. These organizations are given the right to award qualifications through legislation, or they are empowered by a national authority. See Box 5 for two examples of such assessment centres in the United Kingdom.

- In the CIS (Commonwealth of Independent States) countries, including Russia, TVET institutions are the key players in the qualifications assessment system. Based on the results of the final certification, TVET graduates are awarded a diploma certifying both successful graduation and qualification. Involvement of industry experts and employers in qualification assessment is typically unsubstantial, which diminishes the reliability of the exam results. Therefore, Russia is gradually moving to the model, which combines final certification with a demonstration exam based on WorldSkills standards, and an independent qualification assessment carried out in independent assessment centres.
- The processes of assessment and awarding qualifications in health care, engineering and other occupations under special government supervision have certain characteristics in all countries. Qualification assessment happens upon degree completion, and national authorities responsible for a given category of occupations are responsible for assessment. The assessment procedure and

content of tasks are guided by the national authority, with the involvement of industry experts. According to this model, a graduate who does not pass the qualification exam is not entitled to perform a job even if he has been awarded a diploma.

Despite these differences in institutional models of qualification assessment, the mode of qualification examination and the assessment tools themselves are almost the same in most countries. Generally, examination combines a theoretical exam and a practical task. The theoretical exam involves completing a test or some written task, while the practical part is a work-related practical task in a simulated environment, e.g. the student is required to grind a part on a machine, prepare a dish, write a program, etc. The two parts of the exam may be split in time, and the time limit for the practical task is set by the amount of time it would have taken to complete in real working conditions (see the case of Finland).

The institutional models of qualification assessment described above were shaped through the course of the XIX-XX centuries. They correspond to national institutional and

Box 5.

## Assessment centres in the UK

**EAL** is the awarding organization for engineering, manufacturing, building services and related sectors. Over 100,000 learners embark on an EAL qualification each year in schools, colleges, universities, private training facilities and workplaces. Each of EAL's recognized centres is allocated a dedicated External Verifier (EV). EAL also provides to the centres a range of learning and assessment resources, from learner guides and delivery support materials to assessment tools.

The City and Guilds of London Institute is the awarding organization in the UK. It offers 37 qualifications in the building services industry, 61 qualifications in business services, and others<sup>27</sup>.

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<sup>27</sup> Gasskov V. (2018) Development Of Occupational Standards, Qualifications and Skills Assessment Instruments (Stock-taking technical report). Project "Applying the G20 Training Strategy: A Partnership of the ILO and the Russian Federation" (2nd Phase).

cultural landscapes and enable a smooth transition into the workplace, confirming the qualifications of both recent graduates and mid-career workers.

National assessment systems are facing new challenges due to the transition to the knowledge economy. These challenges are linked to job polarization and the changing nature of work (these trends are discussed in Section 1):

- **Current socio-economic and technological change is transforming job profiles that were stable during the industrial era**, and is fueling skill instability. Requirements for workers are tightening and becoming more varied, and standardized skills profiles are being replaced by “bespoke” qualifications. In this context, the prime aim when developing new assessment tools is identifying the core skills for the related qualifications, and then measuring those core skills.
- **Another hot topic in skills assessment deals with measuring transferable or universal skills**, the demand for which is accelerating. The key point is that these skills must be assessed in the occupational context rather than on their own.
- **Conducting qualification examinations remains quite costly.** It requires the devel-

opment of intensive tasks, the completion of which requires expensive supplies and remuneration for experts. Thus, institutions responsible for qualification examinations are looking for cost reduction. Some have looked to replace equipment with VR. Developing this kind of substitute for physical equipment could improve access to qualification assessment for students from various TVET schools.

The following section contains an overview of current skills assessment projects and initiatives in TVET, which illustrates the trends mentioned above.

## 2.2 Current skill assessment tools in TVET: looking for new criteria

The need for standardized assessments applicable to measuring the skills of learners, job-seekers and employees is widely recognized across governments, think-tanks, policymakers and experts. On one hand, stakeholders are seeking to improve conventional standardized assessment and measurements of skills and qualifications. On the other hand, they are seeking new approaches to skills assessment and are attempting to identify the core skills that are in-demand, despite growing skills instability and the transformation of job profiles. One of the initiatives that is attempting to rethink conventional assessment of learning outcomes is the COMET project (Box 6).

Employers in both advanced and developing economies report growing demand for transferable skills that are applicable to any profession and shape professional success. Awareness of the significance of these skills has contributed to the emergence of new assessment tools. The WorkKeys project launched by the ACT (American College of Testing), one of the leaders in standardized testing in the U.S, is one such assessment initiative (Box 7).

Striking features of the WorkKeys assessments include tests that are based on situations in the everyday working world, as well as a built-in function that links the level of skill proficiency with those required in actual occupations. WorkKeys assessments is linked to the ACT JobPro database, which lists the skills profiles of 90% of U.S. jobs. JobPro skills profiles for various jobs are used to determine the skills requirements that are tested by WorkKeys assessments. After passing the test, a job-seeker receives his skill proficiency level and can compare this with the level required in the chosen occupation.

The issue of objectively assessing the skills of new graduates in terms of their employability and credentials is significant for emerging economies marked by large informal employment and a high dropout rate for school children. This is an urgent issue for India, an economy with a big youth population and a high rate of youth unemployment. In an effort to facilitate hiring, Aspiring Minds, an Indian company, has launched the educational project AMCAT (Aspiring Minds' Computer Adaptive Test) in 2008 (Box 8).

This glimpse of the current projects of assessing skills in TVET shows that challenges remain to be addressed. Individual countries and companies have been making efforts in developing new innovative approaches to skills measurement which assess a complex set of skills responsive to the needs of the knowledge economy.

Recently, issues of TVET sector development have become one of the most often debated topics of both national and international agendas. A key point of contention comes from the fact that until recently, the majority of international labor migrants have been high-skilled workers or employees of multinational corporations, while blue-collar workers have mostly found employment on domestic labor markets.

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<sup>28</sup> Zhao Z., Zhou Y. (2019) Professional Competence Assessment Diagnostics as an Instrument for Quality Assurance in TVET / S. McGrath et al. (eds.), Handbook of Vocational Education and Training. Springer Nature Switzerland AG. Rauner F., Heinemann L., Maurer A., Haasler B., Erdwien B., Martens T. (2013) Competence Development and Assessment in TVET (COMET) Theoretical Framework and Empirical Results. Springer Science+Business Media Dordrecht. Rauner F., Heinemann L., Hauschildt U., Piening D. (2012) Project Report: COMET-Pilot Test South Africa including the Pilot Test Vocational Identity/Occupational Commitment and Results of the QRC Pilot Project. University of Bremen, TVET Research Group.

Box 6.

## The COMET project

**The German project COMET** (Competence Development and Assessment in TVET) is an ambitious effort to test a methodology for competence diagnostics in TVET.

The COMET assessment includes four test tasks which take 120 minutes to complete, test instruments measuring vocational identity, and context questionnaires. The design of the test tasks is based on typical professional tasks, and are domain-specific.

In order to develop test tasks and assess the test participants' solutions, the COMET has established eight criteria to evaluate the task solutions.

The eight criteria are clarity/presentation, functionality/operability, sustainability/utility, efficiency/effectiveness, business and work process orientation, social acceptability, environmental compatibility, and creativity. The COMET assessment is expected to compare training quality across TVET institutions and countries. The pilot COMET test was successfully run in Germany, China, and South Africa. The COMET assessment model has been accepted and is continuing to be developed through research and TVET practices in various countries, especially Germany and China<sup>28</sup>.

Box 7.

## ACT WorkKeys

Since their launch in 1992, the WorkKeys assessments have targeted measuring foundational workplace skills. The mission of ACT WorkKeys is to enable a smooth transition from school to work and build the work readiness of new graduates. There are 11 WorkKeys computer-based skills assessments, including applied mathematics, graphic literacy, workplace documents, business writing, etc. Job-seekers who pass the three assessments in applied mathematics, graphic literacy, and workplace documents qualify for ACT's National Career Readiness Certificate (NCRC).

They can earn one of four possible levels of readiness on the certificate (from bronze to platinum).

The ACT NCRC is nationally recognized, with more than 22 thousand employers recognizing NCRC as a credential that certifies foundational workplace skills. More than 20 million WorkKeys assessments were passed since 1992, and more than 4 million ACT NCRC certificates have been issued since 2006. NCRC is beneficial for employers, as there is a significant decrease in recruiting costs<sup>29</sup>.

Box 8.

## The AMCAT project

AMCAT is a computer adaptive test, meaning that the test changes based on a user's answers. The AMCAT syllabus encompasses five modules. The assessment measures aptitude in English, quantitative ability, logic, and information gathering. The last part is an overall personality assessment of the candidate and is based on the five-factor model of personality.

AMCAT is targeted at qualified job-seekers, especially in the IT sector. Therefore, besides the five compulsory modules, AMCAT syllabus provides optional modules assessing applied skills, mostly in Computer Science.

AMCAT is widely recognized in India. By 2019 more than 2 million people in India have taken AMCAT, and 700+ companies are using it as a compulsory testing mechanism for entry-level roles<sup>30</sup>.

Due to globalization and a new division of labor on an international level, blue-collar workers are now entering the international labor market. Therefore, the issues of what is required of middle-skilled workers and the comparability of blue-collar qualifications has put on the international agenda. This calls for developing unified training standards and assessment procedures in TVET across countries.

This is one of the reasons for the growing popularity of the WorldSkills movement, which is covered in the next section of the report.

<sup>29</sup> Anderson S., Harris R., Fluharty M., McMahon J. (2018), ACT WorkKeys Solutions 101, ACT Workforce Summit Pre-Conference. ACT Workforce Summit 2018. ACT WorkKeys. <https://www.act.org/content/act/en/products-and-services/workkeys-for-job-seekers.html>

<sup>30</sup> AMCAT. <https://www.myamcat.com//>







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# 3

## Skills assessment within WorldSkills methodology: emerging capabilities

### 3.1 WorldSkills competitions: from an elitist championship to broad education and teaching practice

WorldSkills is one of the most influential international movements aiming to enhance the image of TVET and the prestige of blue-collar occupations through skills competitions. Launched in Spain in 1950 as a competition for artisans, WorldSkills has built an impressive presence in the TVET world arena, with a constantly expanding number of participating countries and skills covered by biennial international skills competitions.

Held every two years, the WorldSkills competition is the biggest vocational education event in the world that highlights the best practices of modern skill training. Competitors, who are mostly under the age of 23, are selected through competitions in many countries and regions. They demonstrate their technical ability, both individually and collectively, to

execute specific tasks they are studying or already performing at their workplace.

One of the main aspects of the WorldSkills competition is raising the visibility and highlighting the importance of professional education as a tool of socio-economic transformation. The event also provides leaders in industry, government and education with the opportunity to exchange information and the best practices in contemporary industrial technologies and professional education.

WorldSkills competitions are contests of champions, showcasing skill excellence. WorldSkills standards are regarded as a global reference point both for well-established skills (e.g. hairdressing and automobile technologies) and hi-tech & emerging skills (reverse engineering, UAV operation).

At the same time, WorldSkills is not just an elitist network of champions and an organizer of international skills competitions but has a much broader mission: raising global benchmarks and improving skills levels and career opportunities worldwide. In this respect, the TVET sector is the key stakeholder and partner

of the WorldSkills Movement. Thus the TVET sector has become a key channel for promoting WorldSkills Standards at the national and subnational levels in WorldSkills countries.

We give below an overview of the ways in which skills competitions are embedded into national TVET sectors.



## 3.2 How are skills competitions embedded into national TVET systems?

### Australia

Australia uses a competency-based assessment (CBA) methodology for awarding TVET qualifications, and competitions based on WorldSkills standards are a means of moving in this direction. Competitions bring out the best in young people, push them to excel, lift aspirations and, if used effectively, enhance learning.

Competitions are conducted over a two-year period: regional competitions leading to a national competition the following year. The different states and territories are divided into 34 WorldSkills regions for the purposes of conducting the event (Table 1).

Competitions are conducted in 55 TVET institutions, usually as stand-alone events lasting a single day. Assignments (Test Projects) are developed by WorldSkills Australia volunteers, most of whom are TVET educators. Test Projects take into account and are associated with competency units within TVET qualifications.

Test Projects are developed with different degrees of complexity that serve as stepping-stones for moving up through the different levels of competition, as follows:

- **Regional Competitions** – 6-8 hour duration (one day), assignments of a basic level of complexity, intended for a broad range of learners with different experience and skill levels, encompassing the learning outcomes of the entire qualification, irrelevant of the participants' stages of education;
- **National Competitions** – 18-22 hour duration (three days), tasks are more detailed and complex with the inclusion of some aspects of the international level of the competition embedded into the test project.

Table 1. **Australian Skills Competitions in Numbers**

Indicator	2016	2017	2018
Participating institutions	55	59	55
Number of participants	n/a	>3,000	n/a
Number of competitions	n/a	534	n/a
Number of finals	1	–	1
Number of finalists	524	–	490
Preparation hours for students	>60,000	n/a	>60,000

## Netherlands

Skill competitions have become widespread in both vocational education and secondary school in the Netherlands. Competitions are called Skills Heroes for vocational students and Skills Talents for secondary students<sup>31</sup> (Table 2).

VET institutions are actively involved in preparing their students for the skills contests, but this practice does not aim at training champions. Thus schools use contests as a tool to examine all students and not solely top-performing students. Skill competitions have become an integral part of the curriculum and program. In this context, all students and not just contestants benefit from the power of skills.

Let us give a few details on how WorldSkills practices are disseminated and embedded into Dutch TVET institutions.

Assignments and assessment criteria that have been used in previous EuroSkills events and Dutch competitions are stored online in the competition registration system (CRS),

established by WorldSkills Netherlands. This CRS contains over 400 assignments in different disciplines.

VET institutions use these assignments and assessment criteria for day-to-day education after adjusting them to industry needs. Moreover, these tasks are integrating into the skills assessment procedure at each stage of training.

The key point is that WorldSkills standards, adapted to everyday teaching and exam preparation, shape training programs and TVET curricula at the microlevel. Thus the WorldSkills competition approach has been successfully embedded into Dutch vocational education and is making TVET more challenging and effective.

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<sup>31</sup> van Zwieten, J. (2018) Igniting Education: Making more and better use of skills competitions. CINOP Advies and WorldSkills Netherlands.

Table 2. **Dutch Skills Competitions in Numbers**

Indicator	2016	2017	2018
Participating institutions	55	55	56
Number of participants	>3,000	>6,000	>10,000
Number of competitions	34	60	65
Number of finals	34	40	60
Number of finalists	210	410	640
Preparation hours for students	n/a	170,000	>283,000

## Russia

In 2013, the Russian Federation took part for the first time in the international WorldSkills Competition hosted in Leipzig, Germany. Since 2016, WorldSkills practices have been embedded into vocational education in Russia through the implementation of the demonstration exam.

A beta-testing of a demonstration examination was run in 13 regions of the Russian Federation, and the number of regions and skills covered have expanded year by year. More than 50 thousand students from 1,265 TVET institutions in 81 regions have already taken the demonstration exam in 2019 (Table 3). By 2024, all graduates of vocational programs in emerging and in-demand occupations are expected to take the demonstration exam and measure their qualifications against WorldSkills benchmarks.

Assignments for the demonstration exam are developed by the experts of the Union “WorldSkills Russia” in accordance with assignments for national skills competitions.

One of these assignments based on WorldSkills standards is embedded into the final certification in order to measure TVET graduates’ qualifications against international benchmarks. The demonstration exam is run by certified experts. After passing the demonstration exam, the student receives an individual digital SkillsPassport. The data from the SkillsPassport is stored and made available to the WorldSkills Russia partner network and to employers that recognize the demonstration exam result as being an independent certification of technical and professional skills.

Table 3. **Russia WorldSkills Standards Demonstration Exam in Numbers**

Indicator	2017	2018	2019
Participating regions	26	59	81
Participating TVET institutions	244	772	1,265
Number of participants	13,999	30,579	50,718
Registered Demonstration Exam Centers	335	949	1,650

## United Kingdom

From the perspective of government, competitions are a key factor contributing to a number of UK national priorities, in particular in the domain of technical education and apprenticeships. WorldSkills UK also meets a number of broader policy priorities including the UK Industrial Strategy, career counselling and education, and diversity & inclusion.

87% of UK general FE colleges are engaged in WorldSkills UK. A number of training organizations and employers also help to organize competitions in the UK. Education inspection authorities recognize the value of these competitions in promoting better quality training.

The government provides significant core funding to WorldSkills UK. Apprenticeship program funding can also be used to support the costs of participating in skills competitions. Locally and regionally, competitions contribute to improving the professional development of educators, raising the aspirations and motivation of learners, and enhancing employer engagement. These features can help local areas and regions meet their economic and social priorities.

The assignments are developed by specialists working at Competition Organizing Partners. The experts who design the test projects are currently employed in the corresponding industry or educational sector and have certified up-to-date skills.

The role of competitions in TVET curricula and programs varies between organizations and regions of the UK. The more advanced use of competitions in curricula involves competitions being embedded into the curriculum. Moreover, assignments can be used for personal and professional development of educators and trainers. Competitions are also widely employed to showcase organizations to future students or apprentices and to engage in dialogue with employers<sup>32</sup>.

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<sup>32</sup> LSIS (2012), *Inspiring Excellence: A Guide to Embedding Skills Competition Activity in Apprenticeships and Vocational Learning*. Coventry: Learning and Skills Improvement Service.

Table 4. **UK Skills Competitions in Numbers**

87 % of general FE colleges are engaged with WorldSkills UK

>15,500 students involved in competitions

60 competition sectors

200 inclusive competitions in 9 sectors



## 3.3 Benefits of embedding skills competitions based on WorldSkills standards into vocational education

Our study leads to several conclusions on the key benefits of WorldSkills practices for improving quality of vocational education:

- **WorldSkills Standards contain consistent and reliable benchmarks for TVET skills and qualifications.** TVET institutions revise curriculum and learning assessment methodologies on the basis of these well-recognized and reputable standards;
- **Skills competitions offer real career experience:** students are challenged to achieve a level of practice that is professional, in-demand and expected, as well as to master communication and teamwork skills. This learning-by-doing approach helps contestants to make a smooth transition from school to work and fosters the formation of professional identity, independence, and initiative;
- **The WorldSkills methodology supplements the learning process with competitions as a ludic component.** This encourages students to realize their potential and study hard;

Skills competitions appear to be an effective tool for selecting talented students and developing these talents further;

- **The WorldSkills methodology is a benchmark of excellence for the professional development** of TVET teachers and trainers. TVET teachers gain new professional experience and learn new pedagogical approaches while organizing competitions and preparing students for contests, as well as entering international professional networks to share expertise and innovation;
- **Data and experience,** accumulated by WorldSkills, could be a solid ground for developing national skills systems and international comparability, measuring learning outcomes and building individual educational trajectories.

## 3.4 Emerging roles of WorldSkills: from a blue-collar championship to an international benchmark for skills assessment

Skills competitions have emerged as a widespread practice in TVET sectors in various countries. This is demonstrated in the overview of skills competitions embedded in vocational education systems in Australia, Netherlands, Russia and the United Kingdom (section 3.2). Tens of thousands of vocational students have already passed through skills assessments based on WorldSkills standards. In some countries, the vast majority of colleges already participate in skills competitions (e.g. in the United Kingdom). The involvement of TVET institutions in Russia is increasing rapidly. This rapid dissemination of WorldSkills practices in Russia leaves little doubt that in a 3-5-year perspective the bulk of colleges will be involved in assessments of vocational skills based on WSI standards.

The dissemination of skills competitions creates new possibilities for measuring the learning outcomes and skills of TVET students. WorldSkills member organizations already have access to a wealth of data on participants and their skills, and these valuable datasets are of great research interest.

In order to examine the potential for comparative analysis of skills assessment in skills competitions, certified WorldSkills experts have compared assignments and assessment procedures used at national skills competitions in Australia, United Kingdom, Netherlands, Russia, and the International WorldSkills Championship. The three skills covered in this comparison study are Mechanical Engineering CAD, Refrigeration and Air Conditioning, and Electrical Installation. This comparative study is available in appendices.

The key findings of this comparative study are as follows.

Skills competitions assignments are based on WorldSkills Standards Specifications (WSSS)<sup>33</sup>. Member countries adjust international WorldSkills assignments for their national skills competitions. These adjustments include, on the one hand, exclusion of individual parts of the task and reduction of the allotted time for task completion, and on the other, additional requirements and modified structure. However, experts emphasize that the structure and the “core” of the assignments at national skills competitions adhere to the WorldSkills assignments from the international championship.

Thus, the assessment methodology employed at international WorldSkills championships is an international benchmark for skills assessment, which links skills requirements across countries. Following WorldSkills standards is essential for ensuring the comparability of learning outcomes and qualifications awarded across TVET schools and nations. Therefore, this enables countries to improve their global competitiveness not only in terms of training champions but also in terms of a system-wide improvement of workforce skills.

The WorldSkills methodology encompasses both components of an assessment procedure: what is assessed (abilities and skills by occupation) and how to assess (procedure and criteria). Its assessment procedure is highly detailed and itemizes each aspect of performance, criteria, and sub-criteria with relevant weightings. This helps to reduce bias in skills assessment.

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<sup>33</sup> Worldskills Standards Specifications. <https://worldskills.org/what/projects/wsss/>

The WorldSkills methodology shapes assessment procedures and criteria used in national skills competitions – this has become evident from the comparative analysis. This is one more argument for the high potential of comparability among skills assessments within skills competitions, and ultimately among learning outcomes in TVET systems.

New prospects for further unification of skills assessment at international and national competitions could be reached through full or partial automation. This is primarily applicable to skills in engineering, construction, and IT occupations. Pilot projects of skills assessments with automation have already been launched in Russia and China in several fields.



# 4

## Prospects of an international benchmark for skills assessment in TVET

There is a need for tangible evidence on which to ground analysis of the quality of vocational education systems, the efficiency of public and private spending on TVET. Data is also needed for matching graduates' skills with employers' needs. Objective skills assessment provides solid grounds for shaping policies in TVET.

Skills competitions that use WorldSkills standards provide invaluable insights for policy-makers, and could be leveraged in measuring the learning outcomes of TVET students and graduates. The assessment procedure initially developed for international skills championships has transformed into a global benchmark for national and regional standards, and now guides skills assessments across TVET institutions. Further promotion of this global benchmark requires widespread and standardized adoption of WorldSkills practices by national TVET sectors.

Developing valid and reliable assessment tools for skills proficiency requires significant research efforts. There remain challenges to be addressed. How can we simultaneously assess multiple skills, including technical and transferable skills? What are the prospects for measuring digital skills, keeping in mind the increasing digitalization of all occupations? Another issue is associated with the costly procedures of existing skills assessments,

including those that are based on WorldSkills standards. Consideration of these issues requires broad discussion involving researchers, experts, as well as educators and other practitioners.

WorldSkills has made a remarkable contribution to the development of skills assessments, and is one of many initiatives undertaken by individual countries and international organizations. Demand for objective skills assessment in TVET is accelerating in the context of rapid technological change and associated challenges for the TVET sector. At the same time, the risks associated with a lack of coordination of initiatives and projects in skills assessment also are increasing. There is already an example of such a mismatch in the development of assessment tools for measuring transferable skills.

Tackling these issues requires the active engagement of the international organizations and national think-tanks that shape and guide the TVET policy agenda. We should join hands in tackling the challenges facing TVET and fuel the engagement of national and international stakeholders in the pursuit of developing international standards for skills assessment in TVET. The ultimate goal of such initiatives is more inclusive and equal access of youth to the labor market.



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Russia  
juniors

world skills  
Russia  
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ДОБРЕНЬКИЙ  
ДМИТРИЙ  
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Имя Фамилия  
КОЛОСОВ  
ВОЛАДИМИР

## Appendix.

# Assignments and assessment procedures used at the skills competitions in Australia, United Kingdom, Netherlands, and Russia: a comparative study

- Mechanical Engineering CAD
- Refrigeration and Air Conditioning
- Electrical Installation

## Mechanical Engineering CAD

Mechanical Engineering CAD is a well-established skills competition among international WorldSkills competitions. Initially, it was a competition for drafters equipped with paperboard and paper. Since 2001, all drawings have been executed with professional design software. Currently, the key sponsor of skills competitions in Mechanical Engineering CAD is AutoDesk Inc., one of the global leaders in 3D design and engineering software.

The CAD competition assignment establishes skills requirements for occupations related to 3D modelling of components, parts, metal constructions, and consumer goods. The task includes four modules, each of which requires various skills in mechanical engineering.

- **Module A, “Mechanical assemblies and detail drawing for manufacture,”** involves producing a 3D model of a component according to the assembly drawing.
- **In Module B, “Mechanical Fabrication,”** participants model the required sheet metal parts, create frames and various connections.
- **Module C, “Mechanical Design Challenge,”** is dedicated to reviewing a design brief and creating a new version of the design.
- **Module D, “Reverse Engineering from a Physical Model,”** involves 3D modelling a physical part, then producing its drawing. Finally, participants produce a rendered image of the part.

Member countries make adjustments to international WorldSkills assignments when embedding assignments in their national competitions. These adjustments include, on the one hand, exclusion of individual parts of the task and reduction of the allotted time for task completion. On the other hand, national assignments are frequently supplemented with additional requirements and modified structure.

The assignment in Mechanical Engineering CAD for the national skills competition in the **Netherlands** involves 3D modelling the product, then reviewing and modifying its design. Participants are not expected to complete the task included in Module D “Reverse Engineering from a Physical Model.” But aside from modelling the product they are also required to produce relevant calculations and a brief cost analysis. In the final result, the assignment starts to look like a true engineering project. Its successful completion requires knowledge in physics and hydraulics in order to make the extra calculations. Participants modify the design of the product, ensuring its performance and taking into account the number of units produced. Furthermore, participants must provide grounds for the choice of materials and create a presentation demonstrating the product and its assembly/disassembly sequence. They are given 2 days to complete the assignment, instead of 4 as in the international competitions.

The assignment in Mechanical Engineering CAD for the national skills competition in the **United Kingdom** is based on the assignment at WorldSkills São Paulo 2015. However, the assignment modifies Module A with simplified tasks as compared to the international benchmark. Module B of the UK assignment involves tasks from Part C of the assignment at WorldSkills Competition 2015 (e.g. building a parametric subassembly). Moreover, in Part B participants must produce an animation similar to the task from Part C, instead of creating two assembly animations.

The CAD assignment used in the demonstration exam in **Russia** contains Modules A, B and C. The first part of the demonstration exam matches the international assignment of Module A both in terms of allotted time and complexity. The second and third parts of the demonstration exam assignment correspond with Module B and C, but the tasks are simplified, and the allotted time is reduced compared to the international benchmark. Thus the tasks of these two parts of the demonstration exam are to be completed in 1 day.

The key features of the assignments and marking schemes for the Mechanical Engineering CAD sections of national and international WorldSkills competitions are presented in table 1.

Table 1. **WorldSkills assignments and Marking Schemes in Mechanical Engineering CAD competitions**

Competition	Number of modules	Allotted time (total hours/ hours per module)	Marks (max)
WorldSkills Abu Dhabi 2017	4	<b>22</b> (6+6+6+4)	<b>100</b> (25 per module)
Netherlands	2	<b>12</b> (6+6)	<b>100</b> (50 per module)
Russian Federation	3	<b>12</b> (6+6)	<b>50</b> Module A – 25 Module B – 12 Module C – 13
United Kingdom	2	<b>12</b> (6+6)	<b>100</b> (50 per module)



The CAD Marking Scheme used at international WorldSkills competitions for assessing contestants' performance measures the following abilities and skills:

- ability to read technical drawings and build a 3D model, transferring dimensions accurately;
- ability to produce digital assemblies and providing a well-performing prototype;
- ability to create usable technical drawings of parts and assemblies;
- ability to demonstrate effective communication and interpersonal skills, and ability to clearly present designs to potential users including high-quality visualizations of a product.

The key criteria for assessing participants' performance include:

- correct dimensions in 3D model components;
- accuracy of placing parts in assemblies;

- adherence to subassembly structures in an assembly;
- presence and accuracy of dimensions in technical drawings;
- compliance with the animation scenario and the quality of assembly animation.

The assessment criteria for the demonstration exam in [Russia](#) and the national skills competition in the [United Kingdom](#) are similar to the CAD Marking Scheme. The differences are in assessing the quality of assembly animations and the level of detail required in describing the attributes of sheet metal components. Performance at national skills competitions in the [Netherlands](#) is assessed by the criteria from the WorldSkills Marking Scheme. However, there are some added criteria due to the specific content of the assignment. For instance, the calculations are checked additionally, and the grounds for choosing materials used in product components are assessed.

## Refrigeration and Air Conditioning

The Refrigeration and Air Conditioning (RAC) competition has always attracted a lot of attention at WorldSkills championships, since RAC engineers are in demand across counties and industries. They install and maintain all types of cooling systems for residential, commercial, and public buildings. These include industrial and cryogenic cooling systems, refrigeration systems, air conditioning systems, and heat pumps.

Refrigeration and Air Conditioning skills are becoming increasingly digital as RAC systems are getting smarter. More intelligent cooling systems enable higher energy efficiency and are important in the move towards sustainable development.

The WorldSkills assignment in RAC encompasses a full list of tasks for an RAC Engineer, from design, installation, and commissioning to service and troubleshooting.

The assignment includes three modules:

- [Module A, "Component fabrication,"](#) involves fabricating a component of a refrigeration system according to specifications. Then this component is built into the system and used in assembling a refrigeration circuit.
- [Module B, "Electrical installation and commissioning,"](#) is dedicated to installing and commissioning a circuit. By completing this task participants demonstrate locksmithing, brazing, and electrical installation skills.
- [Module C, "Fault find and repair,"](#) involves maintenance and service of cooling systems. Contestants are to identify and repair faults, thus performing the tasks of an RAC Service Engineer.

The RAC assignment in the [Russian](#) demonstration exam involves all three modules, but is more focused on maintenance of air condi-

tioning systems and chillers. Brazing skills are tested only in Module A when fabricating a component, while the tasks of Module B are done without brazing, using flare connections. The skill of testing using the relevant tools is assessed in Module C when identifying faults and re-commissioning the equipment. These adjustments in the assignment make it possible to restore the work area to an appropriate condition in a shorter time. The Russian assignment encompasses all sections of WSSS, but the time allotted is limited to 2 days (8 hours per day), instead of the conventional 4 days.

The **British** RAC assignment is developed in a similar manner. The assignment includes simplified versions of modules from the WorldSkills International competition. Instead of fabricating a component in Module A, participants fabricate a section of a refrigeration circuit, which requires more operations than at the international competition. Also, the fabricated component is not installed. Modules B and C are very similar to the international benchmark. The tasks are completed at different training stands, but assess performance of the same set of skills and abilities as at the international championship. Module B features the use of a compressor-condensing unit that allows participants to start installation directly from a liquid line.

The **Dutch** assignment in RAC is focused on design and calculations. Two out of three modules correspond to Module B and C, but instead of component fabrication participants carry out calculations of a heat exchanger according to specifications. Then participants create an air treatment curve and produce a brief cost analysis. All these calculations are checked by performing the tasks in Module B.

**Australia** offers the most adjusted RAC assignment among national skills competitions. The three modules are merged in one, but still assess the whole package of skills of an RAC Engineer. This assignment is more centered on the service and repair of refrigerating systems, which is responsive to industry needs. There is more time for completing tasks in Module C, but the amount of calculations and drawings is increased. Unlike the previous cases, the Australian assignment involves doing more operations of the same type in pursuit of practicing key skills.

The key features of the assignments and marking scheme for the Refrigeration and Air Conditioning sections at national and international WorldSkills competitions are presented in table 2.

Table 2. **WorldSkills assignments and Marking Schemes in Refrigeration and Air Conditioning**

Competition	Number of modules	Allotted time (total hours/ hours per module)	Marks (max)
WorldSkills Abu Dhabi 2017	<b>3</b>	<b>20</b> (3+14+3)	<b>100</b> (13,5+49,6+36,9)
Australia	<b>3</b>	<b>18</b> (15+2+2)	<b>100</b> (11,0+49,0+40,0)
Netherlands	<b>12</b> (2+8+2)	<b>100</b> (20,0+55,0+25,0)	<b>12</b> (2+8+2)
Russian Federation	<b>12</b> (3+8+5)	<b>87,4</b> (23,0+46,6+17,8)	<b>12</b> (3+8+5)
United Kingdom	<b>12</b> (9+2+1)	<b>100</b> (59,5+29,0+11,5)	<b>12</b> (9+2+1)

The RAC Marking Scheme used at international WorldSkills competitions for assessing the performance of the contestants measures the following abilities and skills:

- ability to carry out relevant calculations, appraise, and design RAC systems;
- pipework & brazing skills;
- ability to install RAC systems and their components and test the performance parameters of an RAC system;
- ability to inspect and test an electrically operated RAC system;
- ability to program controllers and commis-

sion an RAC system;

- ability to diagnose and rectify faults in electrically operated RAC services and components.

The assessment is based on the following criteria:

- use of appropriate tools to test an RAC system;
- use of appropriate hand tools and burner;
- controller programming with computer;
- efficiency of time-management;
- workplace safety.

## Electrical Installation

The assignment in Electrical Installation establishes skills requirements for occupations related to designing and installing electrical systems and carrying out maintenance and repairs. The task includes six modules, each of which requires various skills in installing and wiring electrical power and lighting systems. These modules consist of the following: Circuit design, Commissioning and function, Installation of equipment, Installation testing and fault finding, Programming, and Safety (electrical and personal).

Assignments in Electrical Installation run in the [Netherlands](#), [Russia](#) and the [United Kingdom](#) were developed in accordance with the WorldSkills international assignments. Skills competitions in the Netherlands and the United Kingdom are 3 days long, while the Russian demonstration exam takes 2 days. The time allowed for each module varies insignificantly. As for complexity, the Russian and Dutch assignments are consistent with the international one and correspond to a level 4 or 5 electrician's certification.

The Russian assignment at the demonstration exam encompasses all WSSS sections. However, the number of operations to complete the tasks, as well as time allotted, are reduced.

The UK assignment in Electrical Installation is a simplified version of the interna-

tional benchmark, and corresponds to a level 3 electrician's certification. It includes only four modules (Measuring and marking out, Testing and inspecting, Fault Finding, and Effective health and safety). Participants are not expected to create a circuit diagram, and the number of consumer units for installation is reduced. The use of programmable logic relays (KNX/PLR/PLC) is also not included in the assessment. Finally, the UK assignment doesn't contain commissioning tasks.

National skills competitions incorporate the specific needs of domestic industries. For instance, participants in the Dutch championship have to program using the DALI protocol (Digital Addressable Lighting Interface). The choice of DALI fits well with the energy efficiency policy in the Netherlands. In general, the Dutch assignment is more focused on installing, maintenance and repair of intelligent energy systems. Meanwhile, the British assignment is more centered on assessing abilities around installation accuracy, and includes the predetermined positioning of the conductors P, N, and PE in a single-phase socket.

The key features of the assignments and marking scheme for the Electrical Installation section at national and international WorldSkills competitions are presented in table 3.

The Marking Scheme in Electrical Installa-

Table 3. **WorldSkills assignments and Marking Schemes in Electrical Installation**

Competition	Amount of modules	Allotted time (total hours/ hours per module)	Marks (max)
WorldSkills Abu Dhabi 2017	8	<b>17</b>	<b>100</b>
Netherlands		<b>15*</b>	<b>100</b>
Russian Federation	8	<b>16</b>	<b>62,25</b>
United Kingdom	4	<b>14</b>	<b>100</b>

\*time is not fixed per day

tion used at WorldSkills international competitions measures the following abilities and skills:

- ability to read, interpret, and revise layouts, circuit drawings and instructions;
- ability to plan installation work using the drawings and documentation provided;
- ability to select and install equipment and wireways, cables, electrical switchboards, and connect equipment according to the instructions provided;
- ability to test installations and set up equipment;
- ability to diagnose electrical installations and identify problems, test and calibrate

measuring equipment, and repair faulty installations.

The assessment procedure used in the Russian demonstration exam matches the WorldSkills Marking Scheme. Table 4 contains details on the differences between the sections in WSSS and the Russian assessment procedure.

The assessment procedure in the Netherlands also corresponds to the international benchmark, while the British competition uses the international procedure to assess the simplified tasks of their national assignment.

Table 4. **Comparing Marking Schemes in Electrical Installation**

Section	WSSS, %	WS Russia, %
Work organization and management	5	5
Communication and interpersonal skills	5	10
Problem solving, innovation, and creativity	5	10
Planning and design	10	5
Installation	35	30
Testing, reporting, and commissioning	25	25
Maintenance, fault finding, and repair	15	15