DIGI4VET:

The use of digital technologies in the project sectors

(chemical industry, painting, floristry)

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Contents

The Digi4VET partners are: SBG-Dresden (DE), Zone College (NL), Confederatie Bouw (BE), SCP-Serv (CY), and SLD (UK).

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Introduction

The project Digi4VET is designed to aid the introduction of new technology in vocational education and training. It does this in two ways – by looking at the impact of technology on jobs, and therefore new training needs and programme content, and by integrating appropriate technology into the education and training process. Digi4VET focuses on three aspects of new technology for use in teaching and training – augmented reality (AR), virtual reality (VR), and 3-D printing (3DP), but the principles involved are also expected to apply to other emerging technologies.

The project involves partners from three areas – the chemical industry, painting, and floristry – and focuses on occupations at around EQF level 4, as well as supporting teachers and trainers in VET centres and in the workplace.

This report summarises surveys and discussions carried out by the project partners in their respective sectors, designed to establish the state of play regarding the use of new technology in the industry and in education and training. A common set of questions were prepared based on the appendix, and adapted by each partner for their sector. A mix of industry and VET personnel were sent questionnaires in early 2019. While the response rates were low, partners also discussed the relevant matters with some of the respondents to arrive at an overall picture for the industry.

The results of this report, along with the preliminary work done for the project application, is being used to inform the learning scenarios and trainer training being developed by each partner.

Overview

For the purposes of this exercise, new technologies were defined as virtual reality/simulation, augmented reality, 3-D printing, 3-D scanning, mobile robotics, networked machinery e.g. the 'internet of things', intelligent control systems and intelligent diagnostic/analysis systems. The sectoral reports demonstrate different rates of penetration and understanding of relevant technologies; as might be expected, the chemical industry is generally further advanced than the craft and trade sectors, where the potential offered by the technologies is less well understood.

This section provides a thematic overview, after which the individual reports from each sector are attached.

Summary

The chemical industry already makes use of a range of digital technologies, and scope for incorporating further technologies is well-recognised, both for industrial use and in training. Augmented reality in particular is being introduced for industrial and training applications. Skills needs principally relate to technical and related matters, and managing changes to ways of working and training.

Floristry employs some digital technologies, but the sector is dominated by small and often fairly traditional businesses. There is scope to use new technology for visualisation, marketing and training, but greater awareness and understanding of potential is needed both in industry and among trainers.

In painting the main uptake of digital technologies has been among manufacturers and distributors. Small painting and decorating firms are generally sceptical and lack relevant knowledge and skills, although some innovative use of technology is reported such as using drones for spraying. There is scope to use new technologies for simulation in training and for visualisation and marketing, but as with floristry, greater awareness and understanding of potential is needed.

The sectors

The chemical and pharmaceutical industry (DE) is composed principally of large and medium-sized organisations, from 50 to several thousand employees. The industry is already heavily invested in technology and many firms are forward-looking and open to adopting new digital technology, driven by factors such as efficiency, effectiveness, safety and environmental protection.

Floristry (NL) is predominantly an industry of small businesses, many family-owned and operating fairly traditional retail outlets. Many florists are now in competition with supermarkets, and there is a gradual trend towards focusing on the design element and adopting more innovative approaches to sales and marketing. This is however far from the norm across the sector.

Painting and decorating (BE) is similarly dominated by small firms, most in the ‚micro' (1-9 personnel) category. Innovations are typically driven by paint manufacturers, VET institutions and the trade association rather than by individual firms, which can be fairly resistant to change.

Current and planned use of new technologies

In the chemical industry there is already widespread use of digital technology for production and other operations, generally via a standard computer interface. New technology tends to be adopted quickly if there is a good business case for it. Currently, AR, VR and 3D printing are all seen as relevant, with some firms using them now and others preparing or planning to; none regard these technologies as not relevant. AR is seen as having the widest potential, for applications that include instruction, providing data and delegating control operations to workers on the ‚shop floor', and remote inspection and training. Nationally, a new training module has been developed as part of the programme for chemical operators ("digitalization and inter-connected production").

In floristry, there is some use or planned use of technologies such as 3D printing (e.g. for making display mounts), networked machinery, and to a lesser extent AR and other technologies, but many firms see emerging technologies as not generally relevant. Education and training institutions are more open to adopting these technologies, but as yet they are not widely used.

In painting there is some use of new technology for things such as measuring, scanning (e.g. 3D scanning to provide a representation of a room), colour reading, and drones for spraying. Manufacturers and distributors are generally more advanced in their use of technology than painting firms, many of whom are sceptical of any benefits from adopting new technologies.

Barriers to uptake

There are barriers to using new technology throughout, and widespread views that the technologies that have been adopted are not being used to their full potential.

A common theme restricting uptake among both employers and VET establishments is cost, both of investment in hardware and/or software, and implementation, including training and sparing time from day-to-day activities. In the chemical industry there is some indication of delayed uptake due to waiting for improved or cheaper equipment. In painting and floristry, outright costs are a barrier to small firms.

A second major barrier is lack of knowledge. Particularly in floristry and painting this starts with lack of awareness of what the technology can do or the possibilities it offers, leading to scepticism, lack of innovative leadership, and slow adoption. This is present to a lesser extent in the chemical industry. A lack of knowledge to use the technology to its full potential is also apparent, sometimes accompanied by difficulty finding training that is relevant.

Impact and potential

The only field where there is a clear impact from the technologies under discussion is the chemical industry, although even there the effects are mainly as a result of piloting or small-scale adoption. These include the potential for new ways of working, for instance using AR to expand the ability of shop-floor staff to make operational decisions, and training, for instance remotely or for increasing speed and effectiveness.

In both floristry and painting, there is potential to use new technologies for marketing and sales, for instance for visualisation of colour schemes or designs and (for floristry) streamlining e-sales. In training, there is potential to use VR for simulation, both in painting for things such as technique and calculations, and in floristry for plant selection and design.

Skill needs

Most projected current skill needs, both in industry and for trainers, relate to technical user skills for the relevant equipment and software, although there is also a need particularly among trainers in painting and floristry for understanding of the possibilities and applications offered by relevant technology. In the chemical industry, trainer requirements extend to simple programming, for instance to integrate AR scenarios into training.

The introduction of new technology is also creating demands for related skills and knowledge, for instance for data security, privacy and data protection. There is also recognition of needs relating to the impact of the technology on ways of working, which will impact on the organisation and management of work and training processes.

DIGI4VET: German National report on use of digital media in training in the chemical industry

Author: Jens Hofmann (SBG Dresden)

1. Introduction

SBG Dresden is one of the biggest inter-company training centers for the chemical and pharmaceutical industry in Eastern Germany. Our 70 employees train each year approximately 500 apprentices (such as chemical lab technicians, chemical operators, and pharmaceutical operators) and around 100 middle level managers of the chemical and pharmaceutical industry (such as “Industriemeister/-in FR Chemie”, “Industriemeister/-in FR Pharmazie).

As a practical training provider in the frame of the German Dual VET System, we are a service provider to companies, in order to fulfill the training plan for the relevant occupational profiles. In addition, we work closely together with vocational schools to ensure the qualification of future professional workers.

The report presents the findings of a survey, which was carried out online in March-May 2019. The survey targeted managers and VET trainers for chemistry and pharmacy at SBG Dresden and from other selected companies. Altogether we obtained 4 responses. The rather smalle sample helped to get an in depth-view of use of digital media and the whishes concerning the training for and the use of Augmented Reality, Virtual Reality and 3D printing in the classroom as well as in practical training environments in training chemical lab technicians (“Chemikant”).

Please note: The articulated needs of the chemical companies in Germany, in the field of digitalization, were bundled in a new elective (“digitalization and inter-connected production”) for the chemical operator in 2018. The knowledge about the contents of the elective frame the survey and support it strongly.

2. Overview of the education and training market in the chemical industry

The German "Digital Agenda 2014-2017" of the German Federal Government formulates seven spheres of activities. In sphere No. 5 (education and research) activities for vocational education and training are described (strategy for digital learning, evaluation of qualification needs and forms in first vocational training and further training).

Derived from it was the joint initiative "Vocational education and training 4.0" ("Berufsbildung 4.0) of the Federal Ministry of Education and Research and the Federal Ministry for Economic Affairs and Energy. The initiative aims to develop measures for an attractive and competitive future vocational education and training. This includes screenings on various industries and occupational profiles, to estimate the demand on media competences for apprentices and VET trainers as well as to forecast the demands on future qualified workers (number and qualification needs). Investments in hardware / technical equipment as well as in the qualification of people are the prime focus.

The need for implementing a cohesive strategy is obvious. A Germany wide survey (2016)[1], among 1779 training institutions of different industries, about the use of digital equipment and digital media, showed that for 77% of the training providers' desktop computer with internet access are common. Laptops (48%), Smartphones (45%) and Tablets (28%) are the most common used devices after desktop computers. AR-glasses apply only 18 or 1%, VR glasses 2% and 3D printers were used only by 8% of the interviewed training institutions.[2] The most common used digital media are industry specific software, films, learning programs / WBT and learning platforms.[3]

3. Overview of current use of digital media in chemical industry

Digitalization of the chemical industry started in the 1970s. E.g. the automatic measurement and evaluation of relevant process parameters is since then industry standard. It is common that professional workers are used to master the operation of complex processes with relevant (software) user interfaces. The impact on vocational education and training is diverse as the focus of the chemical training for apprentices is especially on gaining relevant practical skills to master chemical/business processes.

The instruction by standard hardware is common. New hardware, such as tablets, smartphones and smartboards are slightly more used in practical training. Virtual and augmented reality glasses are barely in use currently.

Among the respondents of the survey were SME and major companies from the chemical and pharmaceutical industry. The business activities ranging from the synthesis of specialty chemicals, diagnostics to VET training.

[1] Digital media in companies – today and tomorrow. 2016, p.44. (in German) – source: https://www.bibb.de/veroeffentlichungen/de/publication/show/8048 (accessed: 15.05.2019)
[2] Digital media in companies – today and tomorrow. 2016, p.44. (in German)
[3] Digital media in companies – today and tomorrow. 2016, p.49. (in German)

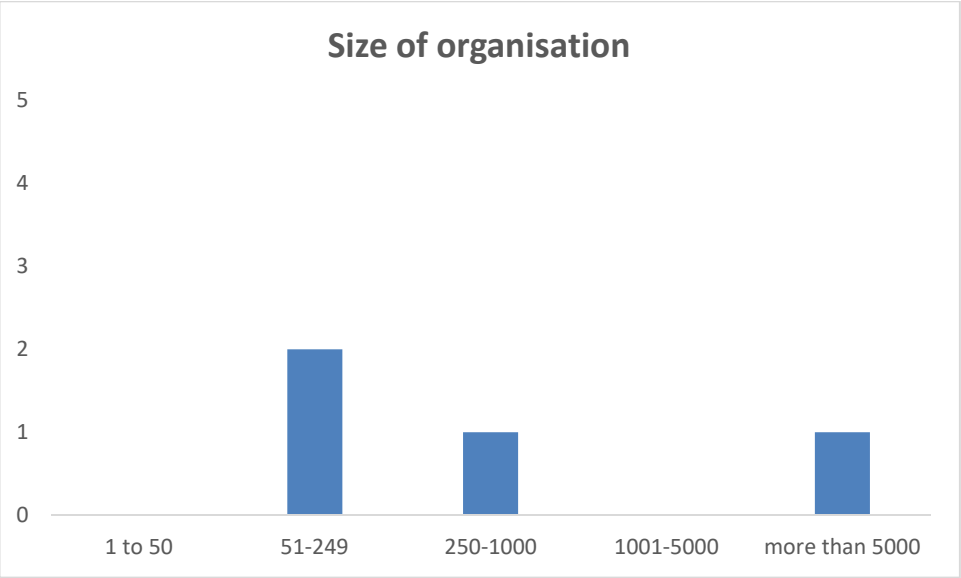

Figure 1 Size of organisation (n=4)

The respondents see their company as either leading in or adapting new technologies rather quickly. This relates to the high degree of mechanization of the chemical and pharmaceutical industry. New technologies will be implemented rather quickly, if they increase e.g. the process efficiency.

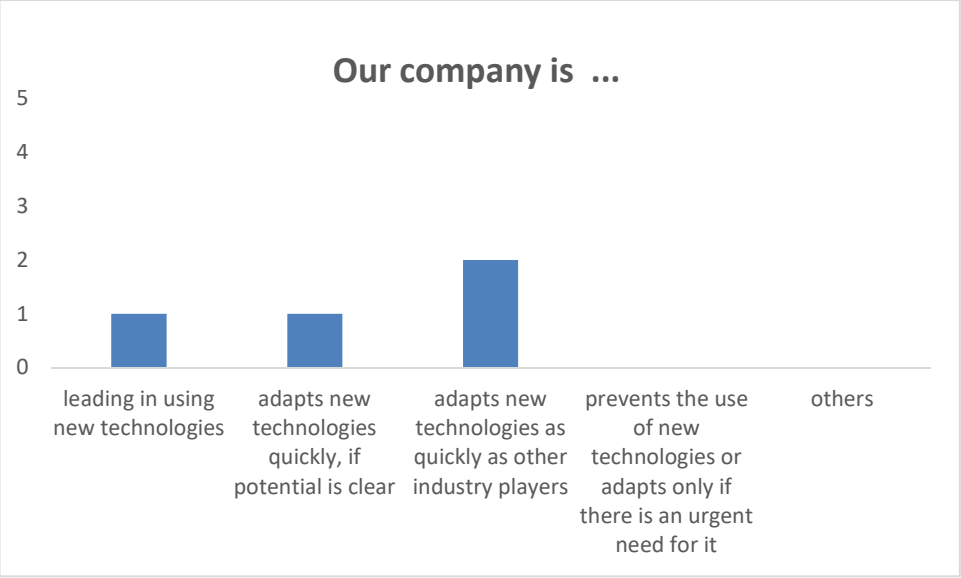

Figure 2 Degree of innovation and adaption of new technologies (n=4)

4. Demands on Augmented reality, Virtual reality and 3D printing

The tendency to enrich the current working and processing environment with technologies, like Augmented Reality (AR) and 3D printers then rather simulating it (e.g. with Virtual Reality (VR)), is apparent. If the technology is useful an implementation in business processes happens rather quickly as figure 3 below shows.

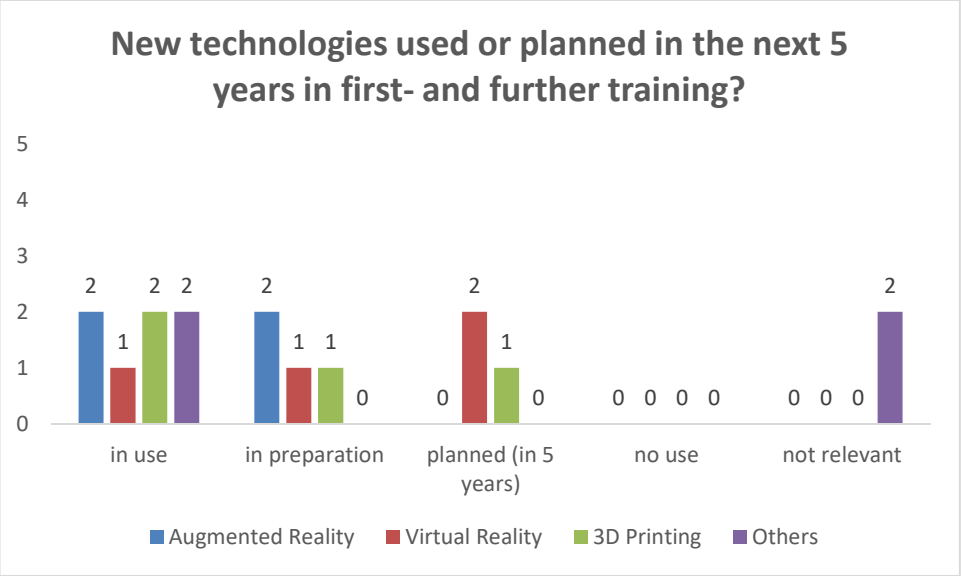

Figure 3 Potential time horizons for applying AR, VR and 3D printing

The use of new technologies provides challenges and opportunities. The use of the full potential of AR, VR or 3D printing is therefore, at this early stage, rather impossible. Further hard- and software improvements by the relevant manufactures might foster further usage scenarios.

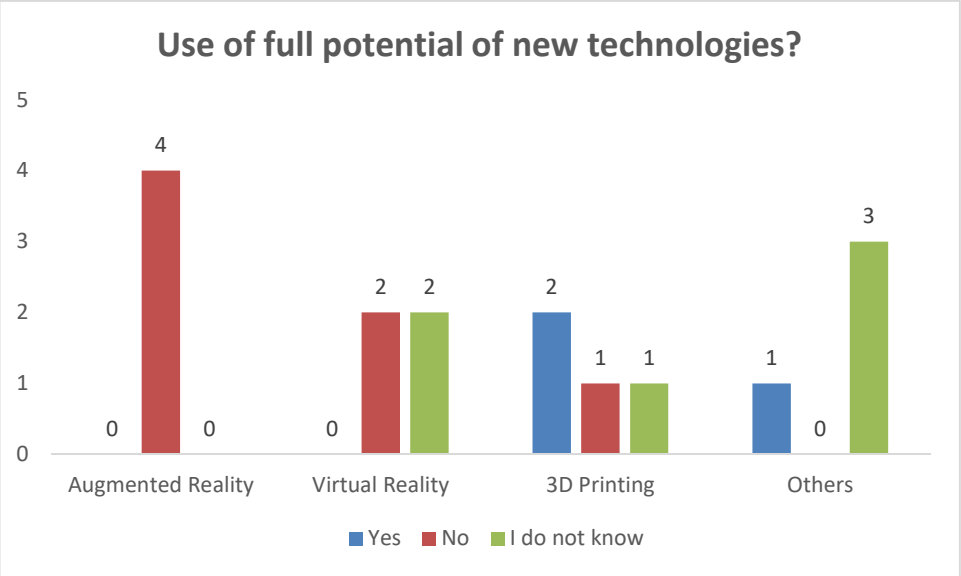

Figure 4 Perceived potential of using AR, VR and 3D printing

The challenges of using new technologies are related mainly to missing knowledge, training and investment costs. Small scale investments foster knowledge to work with new technology and help to apply it to the right problems. Therefore, a rather cost and time efficient use is possible.

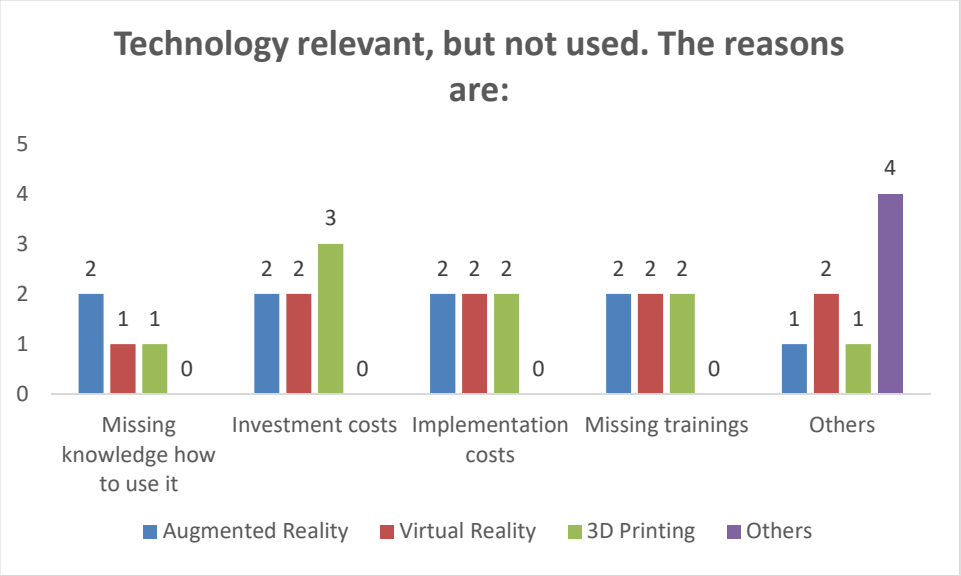

Figure 5 Current and expected challenges of using AR, VR and 3D printing

The use of new technologies will have an impact on current company processes. The degree ranges from a further automatization and simplification to creation of new tasks.

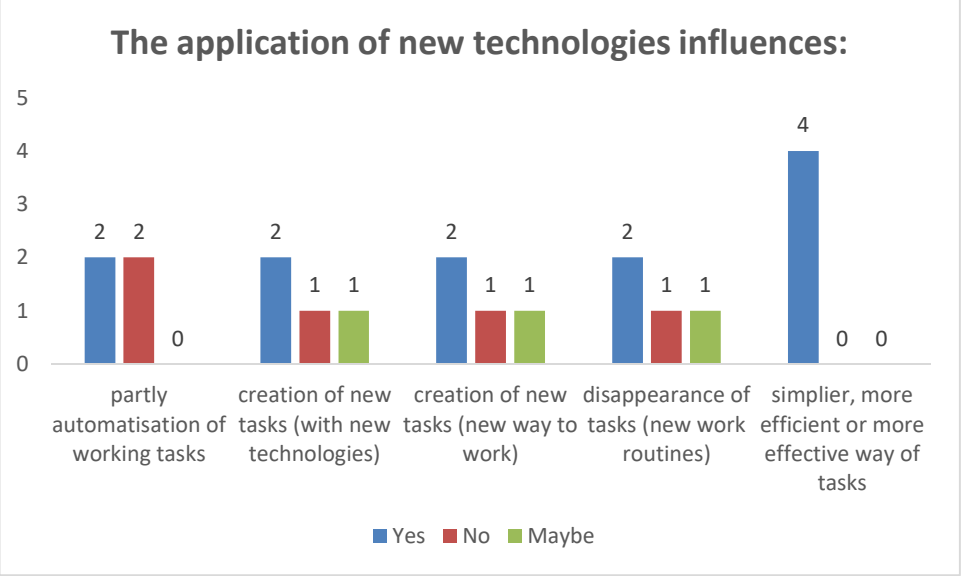

Figure 6 Impact of new technologies

The application of new technologies results in new skills e.g. in the fields of data management, data protection and new working tasks.

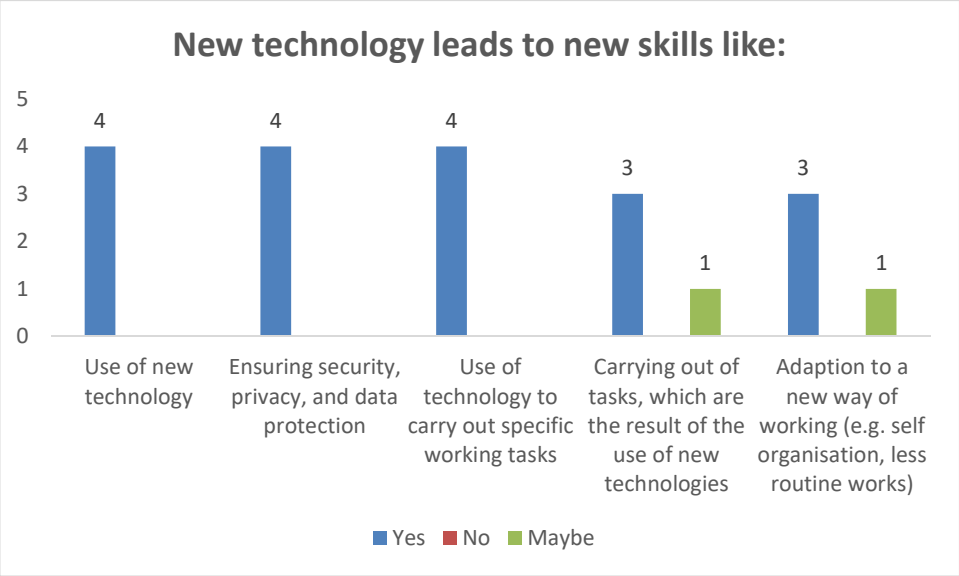

Figure 7 New technology, new skills

5. Further training of teachers/trainers

Trainings, by integrating AR is requested the most, in comparison the VR and 3D printing. This might relate to the currently imagined and expected fields of application as well as the readiness, seen from a personal and company-wide perspective, for working with it.

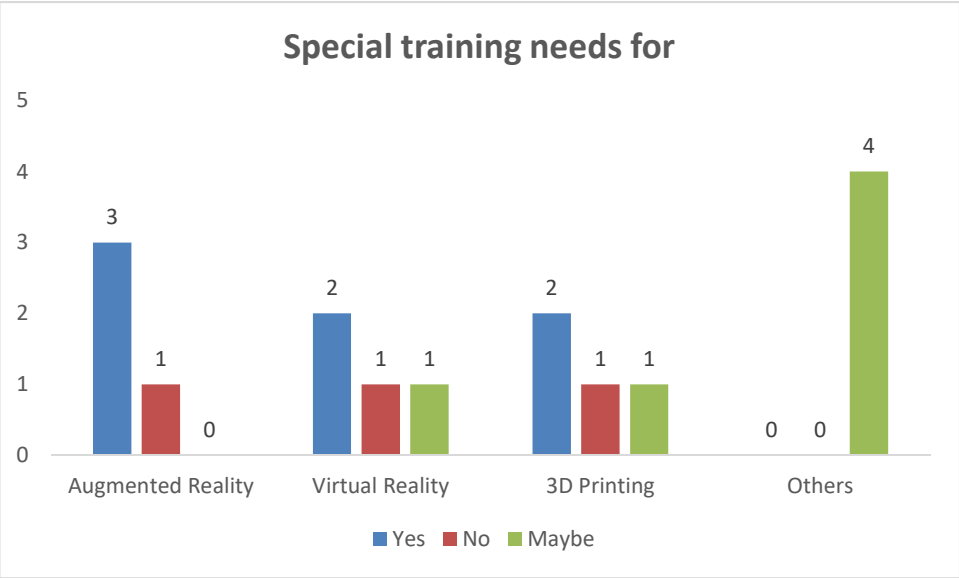

Figure 8 Training needs

6. Outlook

The implementation of new technologies depends on the willingness to invest in and to train employees. As technology progresses the most dominant factor is social acceptance, which is strongly

determined by usability and cost efficacy. Further factors are e.g. mindset of workers to use new technologies, degree of self-directed learning; out-of-date contents in the training plans for chemical operators (e.g. focus to much on mechanical skills) as well as hurdles, like time, training, financing and the difficulties to obtain the relevant technological skills.

AR, VR and 3D printing are rather new technologies and a mainstreaming is expected in up to 5-10 years. This is due that the fact, that in 2019 mainly (expensive) AR and VR glasses exist, relevant contents for the classroom and the (pilot) plant are missing and it is currently difficult for trainers with no programming skills, to create tailor-made AR, VR and 3D printing contents. This prevents that VET-trainers can judge precisely the didactical value added of AR, VR and 3D printing and sketch possible future teaching and learning scenarios for the classroom and for the chemical (pilot) plant.

However, it is expected that the costs of AR, VR and 3D printing hardware will decrease over time and more easy applicable software, for creating e.g. AR, VR and 3D contents, will be available. Alongside with the education of VET trainers by e.g. workshops and blended learning offers, new teaching and learning experiences are suitable.

The focus in the chemical and pharmaceutical industry will be on Augmented Reality scenarios and rather less on Virtual Reality and 3D printing scenarios. It is expected that new forms of learning (e.g. remote training) for real-time instructed learning will be more in use as well a more explorative and self-directed learning, when working with e.g. simulated parts of machines. In the future the implementation of e.g. process data in real-time in 3D models will be expected. It is expected, that it will help the learner or worker to deal better with the necessary process parameters in the chemical plant.

Digi4VET: Netherlands national report on use of digital media in training in floristry

Report on the Questionnaire 'digitalization in floristry'

Zone College (NL)

We have performed a digital survey in microsoft forms under

1. colleague flower teachers
2. entrepreneurs (flower shops)
3. Others, such as trade and industry organizations.

We have sent about 90 e-mails and received 17 replies. The average response time for the survey was 30 minutes.

The majority of the answers came from education (72%); roles in the organization vary from teacher to director, see figure 1 and 2

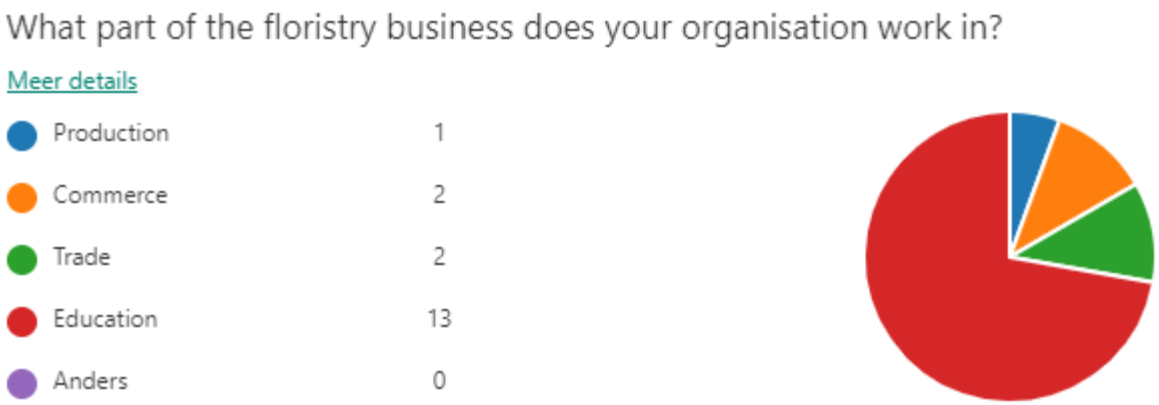

Figure 1

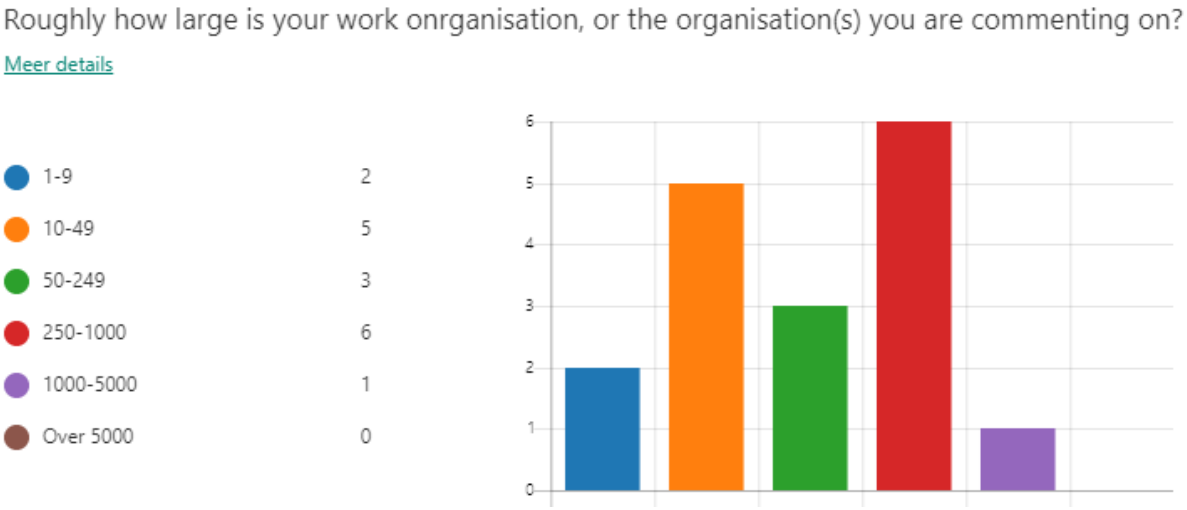

Figure 2

With this research we have tried to find out to what extent organizations in the flower industry consider themselves sufficiently equipped when it comes to researching and using new technological developments. The risk that must be recognized here is that it is difficult to find out from the survey whether the respondents are

- unconsciously unable; or

- Consciously incompetent

In particular, we asked about the progress regarding augmented reality / virtual reality / 3D printing / intelligent control systems / intelligent diagnostic and/or analasys systems / networked machinery (IoT).

Figure 3

Overall, it can be said that about half of the organizations already use one or more of these technologies, or expect to use them within the next 5 years. The remaining 50% do not use these technologies or find them irrelevant (or think that the technology is not relevant). See figure 3.

We also asked for examples of how these technologies are used in practice. A summary of what was mentioned:

- Additional information by QR codes
- 3D printing of materials for use with flower arrangements
- Climate control in flower shops / cold stores
- Automated mail systems
- Streamlining and optimizing processes and ecommerce
- Digital e-books in floristry

Some also suggested options for these technologies:

- the use of AR / VR in (inter) national digital learning environments (MOOCs)
- Use when designing lessons (flexible digital education, learning anywhere - anytime)

Respondents indicate that technology is certainly relevant, but that it is not always used. Mostly AR / VR / 3D printing are mentioned here.

Respondents indicate the following obstacles to the introduction of new technologies:

- insufficient capacity
- too little knowledge
- too few training options
- not enough time
- costs
- unfamiliarity with the new technologies
- necessity is not seen
- lack of innovative leadership
- industry is following, not leading

According to a large majority, there is also room for improvement in the use of existing technologies (see figure 4):

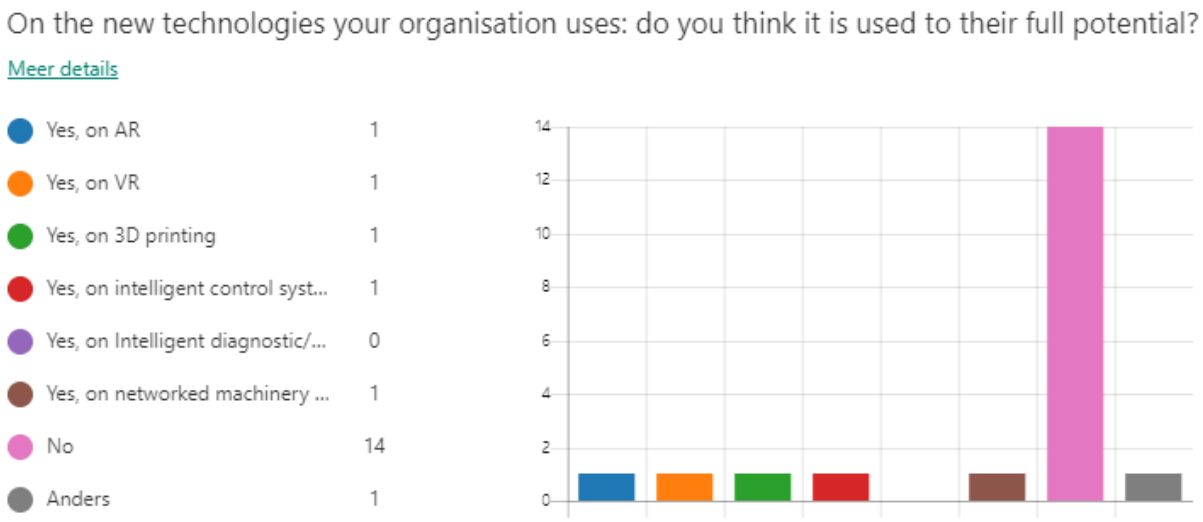

Figure 4

Many of the same arguments are raised about why new technology is not being fully utilized as with the question of barriers. Additional factors that are mentioned are:

- experiments are not shared

- investment costs

- lack of confidence in own abilities

- no insight into the possibilities

- no time to design teaching materials

- not concerned

- lack of technical possibilities

We also asked what effects respondents see as a result of using these new technologies. The most important conclusion is that they are expected

1. That new tasks will arise (as a direct result of the new technology)

2. That new tasks will arise (as a result of a different way of working due to the new technology)

The following are also mentioned: automating, becoming more efficient and facilitating tasks

Specifically for the flower industry, respondents mention "E-selling":

- selling through the internet (using new technologies)

- streamlining the entire marketing and sales process

- new creative forms and expressions

They are then linked to education

- the use of instruction ('virtual visulisaton') by AR and VR

But here too there are respondents who see no application possibilities (unknowingly unable?)

If we ask what new skills, or areas, are needed, people state (see figure 5)

1. Using and working with new technologies

2. Measures concerning security, privacy and data protection

2. Changing role / way of working

4. Performing specific tasks with new technology

5. Performing new tasks made possible by new technology

The high score with regard to security, privacy and data protection is notable, probably due to the increasing awareness in this area in combination with the increasing number of fraud and abuse reports.

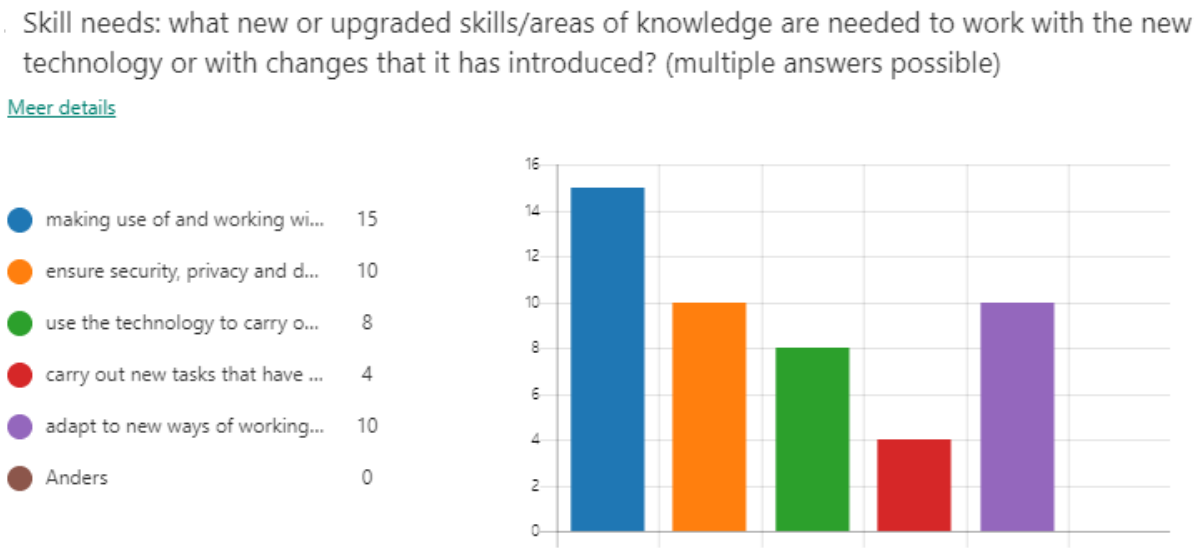

Figure 5

The answer to the question for which new technology new skills are needed is clear (figure 6):

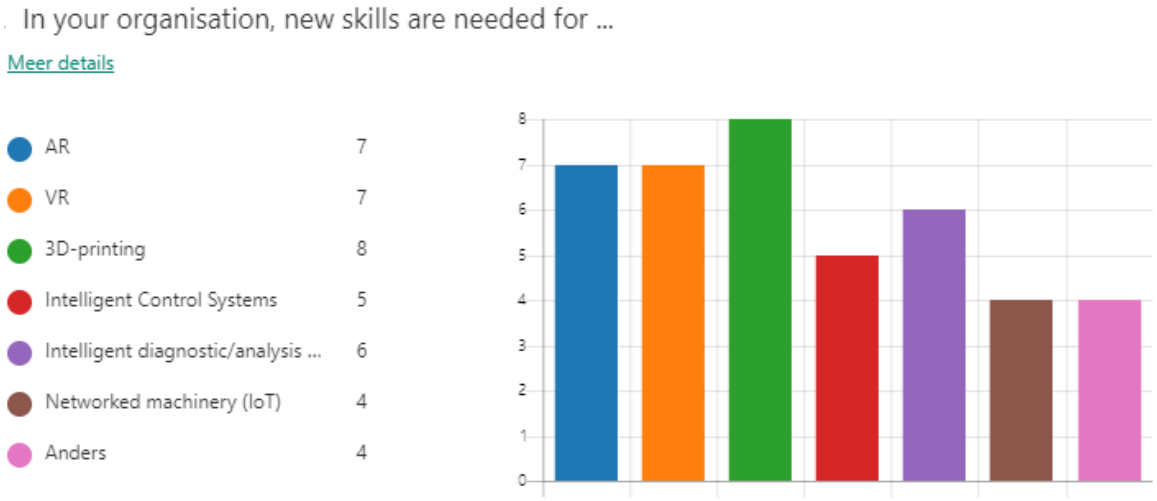

Figure 6

When asked what people see as the biggest barrier (between now and 5 years) on existing workers, they answer:

- Mindset / unable to change / lack of insight into the need for refocusing

- Lack of knowledge about new technologies and opportunities to work together

However, the most striking answer here is "do not know".

With regard to new entrants in the sector, there is mainly a backlog

- understanding / responding to the needs of the customer

- give the new technology a place in education

In general: the implementation of new digital skills in daily work and how this can contribute (growth, other markets, new products).

We asked about the content of the VET curriculum. Is knowledge / are skills outdated, and what are the consequences for the industry? The most notable reactions:

- The floristry industry could be more innovative regarding use of digital technology.
- The current education sometimes uses outdated teaching material. Also, the ideas of lesson developers on parts no longer fit in with the new market demand and developments. We ask for a new craftsmanship with an open mind to the world. There are many initiatives who ask for a different mindset, to approach the subject from a other perspective without affecting the basic conditions of the profession.
- Marketing skills are very old fashioned that don't look at the new way of developing products and innovative/creative products for today's world and how to implement these in a modern marketing strategy.

What are significant barriers to acquiring new skills related to technology?

- training and learning or lack of knowledge

- In my experience, in my present workplace, the main issue is the workers' attitude towards learning new technology skills, including a lack of confidence, but also an attitude of the company in a) not investing in new technology and workers' training, and b) not acknowledging the improved skills by the worker
- The green column is the limitation, it does not happen there Make sure that students come into contact with the possibilities, they make their own choice based on their needs
- Florists are artisans and don't see the need for digitalisation.
- knowledge of where to get help lack of time to learn/ support the development according to staff
- lack of new technology
- Is it useful for the workforce ? Is it asked by the professionals ?
- lack of knowledge where to get help, a lack of confidence with the technology, a high percentage of old teachers
- Mostly capital costs.
- companies often see now additional value in investing in new technologies for their companies
- The managers could be more supportive to their employees wanting to learn about technology, and also to let them use their new digital competence in the shop. Often they work with the same tasks as they did before. So the barriers are often the old fashioned managers with less focus on innovation, how to implement new technology in our flower shop. At my school we have a lot of focus on this new skills relating to technology, but it is difficult to find the time. It comes on top of everything else.

Conclusion

In the 2017-2018 period, the Groene Welle / zone college worked on the KA-2 project "Digital Classrooms & Floristry Vocational Education in Europe". With this project it became clear that the flower industry is looking for ways to prepare current and new employees for the changes that are going on in the flower industry.

With the DIGI4VET project we want to go one step further. To transform the technological changes that we see happening into teaching materials for teachers to train them on how to deploy new technologies in class situations. And how they can introduce students to this new technologie, let them work with it and let them think about application possibilities.

With this research we have tried to find out to what extent these ideas live in practice, whether they see a utility and necessity and whether something is actually being done with it. That produces a mixed picture. Overall: a group does not yet see any application possibilities at all, others think that we do too little too late. The question therefore arises as to whether the group that sees no need is not 'unconsciously incompetent'. And whether we, as educational institutions and industry, have to take action to get them involved in new technological developments. On the other hand, it is also a difficult matter. It requires investment in time and resources to make the new technology your own, and to translate it into a lesson situation! We hope to contribute to this with the DIGI4VET project.

DIGI4VET : Belgian National Report on use of digital media in training in the painting industry

Author: Dirk Van Kerckhove (Confederatie Bouw – Belgische Schilders)

1: Introduction

Confederatie Bouw Belgische Schilders is the national professional association of the Belgian painting contractors. We have about 700 companies that are member of our association.

Many of our members are also involved as members of the jury in different schools and some of them are actually also trainers who are very close to the trainees.

The association is also represented in working group which are composing the content of the study program to become a painter. Therefore they collaborate with Constructiv, which is a national organization for the construction sector which is the representative towards the government in the different Regions.

This report is presenting the results of a survey that we have carried out during March -April 2019. It was send to all our boardmembers as wel as towards schools and trainingcenters and also to the manufacturers with whom we are having a close relationship. In total we send it out to more than 80 contactpersons. Although we only received 6 replys to our survey, the reaction came from different stakeholders so we can still make a good evaluation on how Virtual Reality is considered in the painting community and how everybody is looking and interpreting it.

Before introducing the DIGI4VET project, we also have send out an inquiry to get to know the feeling on how it could/would be accepted within the training and school context. The results of that inquiry were also very positive and gave us the confirmation that there is a need to have a deeper and pedagogue support guideline to be worked out.

2. Overview of the education and training market in the painting industry

The Belgian education and training system is a regional matter and therefor treated by the 3 regions: Flanders, Wallonia and Brussels. Although the content of the painting training should be the same at the end of the formation, each region can decide on how to come to that required level.
On top of this complex situation these regions have several school groups who work individually.

During the vocational education and the dual training system the student will acquire skills part-time by education at school or training center and part-time by education on the work floor. This can be different in each region.

Since our companies are noticing that there is a lack of interest in the painting profession, a (re)boost is something that is very much wanted. The profession should be made attractive to young people who are at a point where they have to decide which profession they want to do for a living.

3. Overview of current use of digital media in painting industry

The painting sector has first started to use digital media in using tools to measure up a room or a house. That has made it more easily to work quicker in measuring up and be more precise in the calculation afterwards.

The painting profession is a real manual one, a painter always uses his hands to operate his different handlings in order to get a job done: sanding down a wall, painting, hanging up wallpaper, spraying movable object,…

Some of the ditributors/fabricants have already developed tools to choose colors or to imitate certain operations done by a painter. But this is always on a very limited scale that it can be used or consultated.

The respondants of the inquiry were some small entreprises as wel as some trainers from VET and other aplications.

They have notice of some existing technologies that are already in use now:

- The use of drones for painting
- 3D scanning of rooms
- Color advice given after using a colorreader
- Spraying a radiator in VR
- …

4. Demands on Augmented reality, Virtual reality and 3D printing

It's very important to have not only the teachers and trainers to be teached. The parents and the pupils must also be convinced of the advantage of using this new technologie. One must be open for it and see the added value of new teaching methods.

They should learn how to think and create in a different way and this might even get a beter of quicker result than without AR or VR.

Empoyers are rather sceptic about this type of training. They think they will have to invest to much money in it in order to get advantage out of it. They are not prepared to do that investment.

5. Further training of teachers/trainers

Important will be that the level of the courses should be given at a level whereby everyone can still follow what is teached.

For existing workers it will be interesting to be able to inform them of new painting systems, and this in a way that they can easily understand the difference compared to an existing system

Using these tools can be very useful to overcome a language problem that might appear when pupils or workmen with a different language are trained. This type of training method might be a big advantage to understand quicker what is meant to be understood;

An advantage of this way of training could be that it is always the same way of starting from the same starting level and with the same bases.

6. Outlook

It seems complicated to introduce new technologies in the system. Some trainers keep to their teaching method and are not open for changing or adapting it to the new possibilities. Also the investment and the time needed to get to know how to work with it, will be a crucial working point.

From the company side it is not an issue that they will automatically invest in the new technology. They have the idea that introducing this in their business will be to much time consuming and their first goal is to get things done. Also it might be giving a wrong expectation for the young employee to find out that the company cannot offer him/her the newest tools.

Appendix
Responses to the industry questionnaire

1. Respondents

VET/training centre 2 (one >50, one 10-49) ['VET']
Producers association 1 (>50) ['T']
Painting company 3 (all <10) ['P']

2. Attitude to new technology

	All	VET	T	P
lead the field in new technology	1		1	
adopt new technology quickly as soon as it sees a benefit	2	1		1
adopt new technology at about the same rate as the majority of the industry	2	1		1
avoid new technology, or adopt it only when there is a pressing need?	1			1

3. Technologies being used

	In use	Being considered
VET	Digital colour reader for recognising colours	VR for training sprayers
T	Apps for choosing colours Drones for spraying	
P		3D scanning to show interiors in 3D for client (in conjunction with CAD)

4. Barriers to use

VET: Lack of knowledge, investment cost, need for training
Painting company: Very high cost

5. Effect on work tasks

Painting company: Create more work by using technology

6. Knowledge and skills needs

Only one VET organisation answered this question in detail. They saw potential for the use of VR to demonstrate colours etc. to clients and for simulation for training, and a need for skills to implement it among trainers. The organisation saw a need to lead in the use of technology in order to convince employers to follow.

An industry respondent commented that employers were not sufficiently trained (in new technologies) and very sceptical.

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Appendix: Prompts for assessing the effect of technology on an occupation

These prompts are designed both for designing a questionnaire and for discussion in expert groups. It is expected that they will be adapted for the particular occupation and industry.

Definition

The occupation needs to be defined at the start of the session or questionnaire. If there isn't a common definition that everyone will understand – for instance a national VET programme that is familiar to all, or a widely-understood job title – provide either a short definition as in section 1, or a web link.

Context

For a questionnaire, start by getting a picture of the respondent's context. In a discussion group, participants can be asked to say what type of organisation they are from and the perspective from which they are contributing. Contextual questions include:

- Role type – e.g. practitioner (in the occupation being discussed), trainee, manager (of the occupation), industry trainer, VET teacher/trainer, industry expert, researcher/academic.

- Type of organisation or sector of industry – if there are different sectors e.g. production, retail, servicing, or public, private, voluntary. External commentators (the last 3 categories above) can be asked if they are commenting on specific categories.

- Size of organisation – Eurostat categories are <10 people, 10-49, 50-249, and 250+. In some industries it may also be useful to distinguish 1-2s and e.g. 1000+, 5000+. External commentators can be asked if they are mostly involved with a particular category or categories.

- This is more subjective, but it can be useful to ask respondents to assess whether they think their organisations are innovators, early adopters, part of the middle majority, or slow adopters in relation to technology.

Technologies

This question is about 'new' technologies that participants or respondents are using or seeing used. Where technologies are identified, ask what they are being used for. The question can also be split into 'using now' and 'exploring/expected within the next five years'. In a questionnaire it can be useful to pick out technologies relevant to the industry, e.g.:

- virtual reality/simulation
- augmented reality
- 3-D printing
- 3-D scanning
- mobile robotics
- networked machinery e.g. 'internet of things'
- intelligent control systems
- intelligent diagnostic/analysis systems.

A related question can be asked about whether the technology is being used to its full potential, and if not whether this is due to (a) limitations with the technology itself, (b) lack of skills, knowledge or confidence in any part of the organisation, (c) lack of investment e.g. in updated software, or for other reasons.

Tasks

This concerns the effect of the technology on tasks and activities. In a questionnaire, space is needed to allow respondents to reply for multiple technologies if relevant. For each category that is selected, ask the respondent how this is happening; this may involve multiple tasks for one type of technology. Also ask if this is likely to change over the next five years.

- Tasks that are, or are becoming, automated
- Tasks that are partly automated
- Tasks that are no longer needed because ways of working have changed
- Tasks that are made easier or made more effective or efficient
- New tasks that are being created related to the technology
- New tasks that are being created related to changed ways of working.

Skills needs

This question is closely related to the two above, but it is not the same – as some new or changed tasks, and operation of technology, can be learned quickly on the job. Ask what new skills are needed to:

- Use and work with new technology
- Use the technology to carry out specific tasks
- Carry out new tasks that have been created as a result of the technology (this could be for instance to move from an 'operating' role to one concerned with setting-up and quality assurance)
- Adapt to new ways of working (for instance the need to be more self-organising and take responsibility for day-to-day work, or where the role has broadened due to less time being spent on routine tasks).

Where new skills are identified, it is also useful to identify the level of ability needed – possibly split by newly-qualified entrants and experienced workers. A simple scale (such as novice to expert or a simple three-point scale) can be useful for this.

Where are the most pressing skills gaps – now and predicted over the next five years – for (a) existing workers and (b) new entrants (coming in from VET programmes or similar)?

Skills redundancy

This question asks whether any skills currently associated with the occupation/taught on VET programmes are no longer needed. Ask for the implications of losing the skills: could they still be needed for bespoke applications, or for contingencies and breakdowns?

Barriers to learning

This question is particularly relevant to upskilling the existing workforce.

In the occupation/industry, are there any particular barriers to being able to acquire new skills? Some pointers can be provided, e.g. factors concerning time at work or to get away from work, the way work tasks are organised, knowledge of where to get help, workers' attitudes to training/learning, managers' attitudes to supporting training/learning or to releasing staff, etc.