EXPERT GUIDELINES

FOR MANUFACTURING SPECIALISTS' TRAINING ON SUSTAINABILITY

1. INTRODUCTION

The purpose of this document is to provide guidance to vocational education and training (VET) specialists drafting training programs and teachers preparing lectures and trainings of manufacturing sector qualified workers with focus on sustainability. The document can be used by high school specialists and lecturers for the same purpose, but illustrations and guiding questions shall be adapted correspondingly. The document provides core ideas, aspects of sustainability to teach, train and promote.

Although this document is not intended to be a prescribed course outline or "how to" list, it is intended to emphasize the essential components of a successful learning of the subject. Therefore, these guidelines can also be used by teachers of general education institutions, by employees of institutions and other stakeholders as well as personnel and human resources staff of manufacturing companies.

The guidelines have been prepared in co-operation of Vilnius Jerusalem Labor Market Training Center (Lithuania), JSC Smart Innovation (Lithuania), Foundation Smart Minds (Latvia) and Federation of Estonian Engineering Industry (Estonia), implementing ***project "Training of environmentally friendly (sustainable) work culture in the Manufacturing Sector (2Change)" (No: NPAD-2022/10072)*** funded by NORDPLUS Programme[1].

The information required for the preparation of the guidelines was collected by analyzing the legislation, methodological recommendations, training programs and other relevant content in the partner countries. It is also in line with international and national instruments, regulations and standards governing the manufacturing sector, and the legal and regulatory framework defining environmental performance.

2. TERMS AND DEFINITIONS

2.1. Manufacturing **jobs** are defined as those that **create new products either directly from raw materials or components**. These jobs are usually in a factory, plant or mill but can also be in a home, as long as products, not services, are created.

2.2. **Sustainability** is the ability to exist constantly. **Sustainability** means making only such use of natural, renewable resources that people can continue to rely on their yields in the long term.

2.3. **Environmental impact** is defined as any change to the environment, whether adverse or beneficial, resulting from a facility's activities, products, or services. In other words it is the effect that people's actions have on the environment.

[1] https://espresso.diku.no/projects/nordplus?2&lang=en

2.4. **Lifecycle of manufacturing works** – there are four stages in product manufacturing life cycle that include designing and developing the product, transferring technology to commercial-scale production, undertaking commercial manufacturing, and dealing with product discontinuation. Environmental impact includes, but not limits to **carbon footprint**. It is possible make a **lifecycle assessment** of a manufacturing works to find out how it will affect the environment in every stage of lifecycle.

2.5. **Carbon footprint** – the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organization, or community.

3. MAIN ASPECTS OF SUSTAINABILITY

3.1. Definitions

There are many definitions or specific wording concerning different aspects or components of sustainability. It is often used in media, official and non-official announcements or advertisements without any explanation, quite often misguiding not directly involved people. For "sustainable" or "green" today's manufacturing participants necessary to have an understanding of at least some of them.

a) **Life cycle of manufacturing works** – whole existence or all stages starting from extraction of natural resources, transportation, production of materials or products, designing, manufacturing (assembly), use, repair, renovation, demolition, extraction and separation of waste to materials in the same composition or shape found in nature and put back to nature or put to the beginning of other life cycle.

It shall be taken care in every stage of impact on environment including CO2 emission, waste generation and other impacts on. It shall be taken care in every stage of possibility to separate or extract some materials in the same composition or shape found in nature instead of generation of waste.

b) **Circular economy** – an economic system aimed at eliminating waste and the continual use of resources. Circular systems employ reuse, sharing, repair, refurbishments, remanufacturing and recycling to create a close-loop system, minimizing the use of resource inputs and the creation of waste, pollution and carbon emissions. The circular economy aims to keep products, equipment and infrastructure in use for longer, thus improving the productivity of these resources. It does not mean a drop in the quality of life for consumers, it allowing us to keep enjoying similar products and services.

Illustration: All 'waste' should become 'food' for another process: either a by-product or by recovered resource, or as regenerative resources for nature, e.g. compost.

Guiding questions: What waste in manufacturing site can be a raw material for another (or next) work?

c) **Energy efficiency**: reducing the energy required per unit of production. This reduces the energy cost by reducing the volumes used.

d) **Carbon intensity reduction**: replacing the energy used with low carbon energy. This reduces the cost of CO2 emissions depending on local regulations and taxes.

e) **Energy flexibility**: adapting its energy use to market conditions (energy mix, level of consumption…) to optimise the purchase price. This will reduce the unit price of the energy used.

f) **Green Manufacturing, also known as Lean & Green**, is an approach to evaluating and improving the manufacturing process. It's based on Lean manufacturing principles and thus provides a dynamic, proven, and successful approach to going green.

g) **ISO 14001 standard** – is defined as an international environmental management standard specifying requirements for establishing an environmental management policy, determining environmental impacts of products or services, planning environmental objectives, implementing programs to meet objectives, and conducting corrective action and management reviews. Implementation of requirements of the ISO 14001 standard shall be proved by third party certificate.

Illustration: Even producing environmentally non-friendly products company can introduce requirements and get the third party certificate, if it determined environmental impacts of product, have planned environmental objectives and set up programs to meet these objectives.

Guiding questions: A specific requirements of product and services are set in the standard. Can be standard applicable for manufacturing company?

3.2. Green value stream approach in manufacturing

Manufacturing is the process of turning raw materials into finished goods. That, by definition, is not sustainable. A sustainable business creates interchangeable inputs and outputs. It's a closed-loop, also known as cradle to cradle. Ideally, a sustainable manufacturing plant would:

- produce more energy than it uses;
- create more new materials than it uses;
- produce zero waste;
- clean more air and water than it pollutes.

Today reaching just one of the criteria mentioned above is a strong sign of a company's leadership in environmental issues. Reaching all of them is something that seems impossible for most companies.

The Green Manufacturing (also known as Lean & Green) **framework** is built around the 7 Green Value streams and offers a clear vision to strive for in each of them, for example reaching 100% renewable energy powered operations or zero waste sent to landfill. It's also important to note that there currently is no accreditation or external audits for implementing the Green

Manufacturing framework. This framework is useful for manufacturers to improve their processes, track their progress and share that progress with stakeholders.

The difference between Lean and Green is that in the case of Lean, waste is viewed **from the customer perspective**, and in the case of Green – **from the environment's perspective**. The rest of the framework – principles, processes, and tools – are applied in the same way for both Lean and Green, which makes it familiar to manufacturers and therefore easy to apply in practice.

7 wastes of Lean (waste in a non-value-adding activity from the customers perspective): inventory, movement, defects, transportation, overproduction, excess processing, waiting.

7 Green wastes (waste is considered from the environmental perspective): energy, water, materials, transportation, waste to landfill, emissions, biodiversity.

The frameworks used in the lean approach, for example, DMAIC (Define, Measure, Analyze, Improve, Control), can be used also for Green manufacturing implementation. That is possibly the best part about implementing Green – manufacturers can use the same time-tested approaches to tackle waste.

3.3. Energy consumption in manufacturing

Manufacturing operations are faced with many challenges in today's marketplace. **Plants must stay competitive to keep the doors open**; **sell what is manufactured at a cost higher than what it costs to produce**. Global competition says they must be lean and efficient. Production costs can include such items as raw materials, labor, plant and equipment, maintenance, utilities, warehouse and shipping to name a few. Reducing the cost of any of these items can add to the companies' profitability and increase shareholder value. Managerial performance is recognized when production costs are reduced and profits increase.

Operating an efficient plant can improve a company's competitive position. **Well maintained and efficient equipment improves reliability, reduces scrap rate and increases productivity**. Revenue increases through greater productivity. An area often overlooked is utility costs. Depending upon the process, electricity, natural gas or propane, and municipal water costs can be a significant part of the manufacturing cost.

Energy savings don't necessarily mean huge capital improvements within the plant; out with the old and in with the new. Often times control strategies or adjustments can be implemented to manage existing systems. For instance, lighting controls such as motion sensors can be installed to control lighting in areas of the plant seldom used (warehousing). Thousands of dollars can be saved annually just by lowering the operating pressure of the compressed air system. Areas of savings often include:

- **Advanced lighting design, technology, and controls** – LED fixtures replacing less efficient high-intensity discharge (HID such as metal halide and high-pressure sodium) can be quite cost-effective. Often times a lighting redesign allows a reduction in the

number of new LED fixtures and not just a one-for-one replacement. Areas of the plant can be upgraded in phases as the budget allows. Lighting controls can be set up to coincide with production schedules. Do the lights need to be on when the plant is shut down during the third shift?

- **Compressed air optimization** – Many manufacturing operations use compressed air in their operation. Slight adjustments can have significant savings. For instance, slowly lowering the base system operating pressure can have a big impact. Compressor load-unload strategies can offer savings as well. Air piping sizing, receiver/dryer operation is another area to examine for energy savings. Inefficient use of compressed air can be an area of concern as well. For instance, can an air nozzle be timed to blow off metal chips from a part rather than blowing continuously?

- **Process heating or cooling** – Often times energy used for processed heating or cooling can be captured for use elsewhere in the plant. Simple things like insulation blankets on plastic injection molding machines or refrigerant line insulation can provide significant savings. Boiler optimization through advanced controls can have gas savings. Automatic dampers on boiler ventilation can offer energy savings as well.

It can be a challenge to give energy efficiency the time, resources, and budget needed. Some maintain if it's not broken, we're not going to fix it. Others say the manufacturing process is working fine so why worry about energy efficiency? Other barriers include: not understanding the business opportunity to reduce expenses; lack of staff and management awareness; complacency; restrictive budget for capital improvements; relatively low gas and electricity costs; lack of staff resources.

3.4. Energy-efficient production

Energy-efficient production means more than simply reducing energy consumption, CO_2 emissions, or costs – it also involves linking energy and production data in order to analyze and optimize not only energy consumption but also the energy productivity of machines, plants, and processes. These measures provide the opportunity to achieve all-round improvements in process productivity and efficiency.

On average, energy costs account for up to 10% of all production costs. In energy-intensive industries, the percentage can even get up to 40%. Yet it is possible to transform energy into a genuine added value: you can achieve savings of as much as 30% or more with our innovative drive technology, for example.

Energy efficiency is an easy, common and cost-efficient way to decarbonize manufacturing. While it was initially seen as primarily a cost-reduction measure, we now see it as also one of the best decarbonization levers – enabling emission and cost reductions simultaneously, at an implementation price that usually represents a good return on investment. While efficiency measures often seem mature, particularly in the EU, there remains tremendous untapped potential for energy savings as new options emerge – many of which have a payback period of less than four years.

Energy efficiency can be split into two complementary streams: reducing final energy demand (using less energy) and optimizing utilities production (using energy more efficiently). Final energy demand reduction can itself be separated into two categories: technical solutions and employee awareness. Behavioral change should not be overlooked as a key catalyst for industrial decarbonization efforts.

Nonetheless, technical solutions are what may first come to mind – evidenced by our masterclass participants noting their primary focus is on energy-saving projects such as compressed air (pressure optimization, leak control), steam and hot water (thermal insulation, control of networks) and lighting (LEDs, motion and light sensors).

The second stream – optimizing utilities production – brings its own challenges. For instance, questions around how to optimize an energy vector could include whether steam is the right heat carrier to use, or might hot water be sufficient? At what temperature should the heating networks be? Is the combustion on boilers being properly controlled through O^2/CO^2 probes? Are chillers being optimized to external temperatures?

Some of these questions may have easy fixes with a quick payback, immediately saving several percentage points of energy consumption. Reducing the pressure in a compressor by one bar for instance, from 8 to 7, can save 7% of its energy consumption. Chiller optimization can generate up to 15% savings in temperate climates. Replacing old assets, such as a compressor or chiller, can also lead to major savings due to technological advancements.

Many of these fixes might seem like minor system adjustments, but harnessing untapped potential is a critical part of reducing your overall energy consumption. Implementing an energy efficiency program across manufacturing footprint requires sufficient resources and planning, adopting the proper best practices to ensure a successful rollout.

Avoiding Common Energy Efficiency Implementation Pitfalls In Manufacturing

Four common pitfalls impact the success of many energy efficiency programs and demonstrate why it is important to have the right governance and enablers in place to achieve the requisite transformation.

1. Energy Efficiency is Not a One-Off Exercise. The task is not done with a few quick fixes. Organizations should identify energy efficiency champions at each site who will dedicate part of their time to monitoring efficiency and recommending energy saving measures—striking a balance between internal and external expertise. Well-trained people are needed within the company to keep everyone on board with the sustainability efforts, and they should complement more formal efforts to ensure that processes, strategy and KPIs are in place to track performance over time. Creating a transformation is a continuous process requiring company-wide buy-in.

2. Limited Access to CAPEX and/or Limited Use of Financing Solutions. Energy efficiency investments compete with other internal projects for corporate funds, and it's difficult to get

sign off on replacing assets that are technically still working but could be replaced with highly efficient alternatives. Identifying subsidies to lower investment costs and avoiding a project-by-project approach can help, but the best option is to change the mindset about investments from looking at return on investment (ROI) to total cost of ownership (TCO). Establishing a baseline and comparing the long-term impact of implementing changes with taking no action will typically show cost savings or no added cost, while simultaneously locking in efficiency benefits for the future.

3. Gap to Implementation. Another oft-cited example is when a company has actually developed an energy efficiency action plan and equipped it with a budget, but those funds never get spent. Again, this is an issue of site teams wanting to spend those funds on production rather than efficiency, because they mistakenly do not see efficiency as beneficial to the company's bottom line. What this shows is that without the proper governance and mindset, even a well-considered efficiency model will not be implemented. Along with ensuring the right expertise, management must employ the right governance with the proper incentives to see that corporate targets are cascaded down to individual sites.

4. Non-Scalability. Most of the time, energy efficiency projects are still implemented on a site-by-site basis, rather than programmatically. It is critical that the tools and efficiency mentality are in place to enable the sharing of best practices with partners, instead of reinventing the wheel every time a site needs to optimize its energy solutions. If a lever is identified at one site, it should be shared with a partner site, creating synergies and transversality. There is a great deal of potential value to tap into with programmatic practices, and they can help your organization accelerate decarbonization at pace and scale.

3.5. Waste management

What Are the 7 Green Wastes?

Energy. In this context, energy refers to electricity and fuels (such as natural gas) to power electrical and mechanical devices (e.g., machinery, electronics, heating, and cooling devices as well as ventilation systems). The most common issues with the energy subject are: 1) the wasteful overuse of energy; 2) the source of energy (renewable vs. non-renewable); 3) the fact that you have to buy the energy from someone else.

The end goal for any green manufacturer would be to have their own renewable energy power supply – from sun, wind, or biomass, for example. That's the ultimate opportunity, and competitive advantage as that frees the company from harming the environment due to manufacturing energy needs and frees the manufacturer from purchasing the energy from someone else. With the increasing energy cost and expected future increases, the direct cost savings can be significant.

Water. Water, the second green waste, is essential for pretty much any company. However, manufacturers use and discharge a lot more of it than the average office building. Manufacturing industries that need a lot of water for product treatment include the garment and textile industry (for both growing cotton and dying process), industrial meat production, beverage industry (for both the water inside the drinks, but also for growing water-intense additive crops like sugar, coffee, fruit, etc), and automotive industry (for surface treatment and coating, paint spray booths, washing and rinsing, cooling and other processes).

The manufacturers have to pay for water twice – for the amount of fresh water they use from the municipality and then for the amount of water they discharge back into the system. That's why when the price for water consumption or discharge is increased, manufacturers feel it the most. On top of that, there is only so much water. Companies operating in water-scarce regions have to work on ensuring they will have access to it no matter what – to continue operations.

Materials. The current linear flow of materials in the manufacturing process has created two challenges, both of which are affecting manufacturer profits and sustainability – manufacturers constantly need new raw materials for production, and the product ends up in a landfill after its lifecycle.

More companies than ever before have proven – it doesn't have to be this way. Creating a system for collecting products at the end of the lifecycle can provide valuable materials for your manufacturing plant and save a lot of money usually spent on extracting new materials. The end goal is to find ways to reuse materials and components of the product. And to achieve that, innovation at the design stage is necessary.

Garbage. The environmental impact of garbage is well known. And so is the most common advice on eliminating it – reduce, reuse, recycle. But there is an aspect that's rarely understood about this waste stream – the actual cost of throwing things away.

If you're throwing out an item, you probably paid for it first, then you're paying again to have someone take it away. In case the company is offsetting its emissions, it's actually paying for it the third time as garbage contributes to the company's GHG emissions. Interestingly, a common thing companies discover is that the most expensive waste types in terms of cost of purchasing and disposal are also the ones to bring the most significant environmental benefit—for example, inks, paints, coatings, and oils.

Transportation. This green waste includes the transport of humans, materials, suppliers, and finished goods from one place to another. Its environmental impact is often overlooked, but in Europe alone, the transport sector represents almost a quarter of the greenhouse gas emissions and is the leading cause of air pollution in cities.

The green waste stems from the fact that the current transportation system is inefficient and is run in a manner that is harmful to the environment. And as with other wastes discussed above, eliminating this one also offers cost savings. The end goal here is to move toward 100% use of environmentally friendly modes of transport and offset what is unavoidable.

Emissions. To recap, many aspects contribute to the company's total carbon footprint. The wastes mentioned above would be taken into account when calculating the company's carbon footprint, but there are other impactful aspects to consider, for example: operations of an oven (baking often releases VOCs – volatile organic compounds); HVAC (heating, ventilation, air conditioning systems); emissions caused directly by your product (e.g., if your product is a car, the emissions the product generates once used and at the end of its lifecycle).

The benefit of working on eliminating this waste is twofold. It's reducing the environmental impact of the business, but in many cases, it also helps to alleviate the financial burden of fines and fees.

Biodiversity. This is the last, but not least important waste for Green Manufacturers to consider as it affects both the sustainability of a business and the nature it's surrounded by. Biological diversity is the key to sustaining life on this planet. It's encompassing all living species on earth and their relationship to each other. It's how the trees, bees, plants, birds, and animals interact with each other, depend on each other and provide an ecosystem that can sustain life, generate oxygen, or clean water and soil.

Beyond environmental significance, biodiversity waste matters as companies have significant costs associated with clearing up trees or filling up a watershed to build a new building. The end goal here is to eliminate the destruction of biodiversity and regenerate what has already been taken.

Steps to Eliminate Green Waste

Step 1: Gather data on the current situation. By gathering data from manufacturing business, the manufacturers can set a baseline. In the Energy waste context, manufacturers need to collect data on energy use and source for the whole factory and activity. In the Material waste context, manufacturers would identify the input/output of materials in each activity of the value stream. Sometimes this requires further information gathering, for example, the recyclability or material composition of materials or the type of waste.

Step 2: Increase efficiency, minimize consumption. This is a crucial step that will help manufacturers successfully reach the next steps as it ensures manufacturing operations are as lean and efficient as possible. In this step, manufacturers identify where the opportunities lie for minimizing the use of resources – e.g., switch to more efficient machinery to save energy or water, eliminate unnecessary packaging and reduce the creation of garbage. Often, this phase offers a fast (up to a year) payback period and cost savings after that.

Step 3: Invest in bettering your business. The last step in the process is to leap towards the end goal mentioned in each category. With the savings from Step 2, there's at least part of the budget to invest in becoming a *green manufacturer*. The journey will look different for each aspect of the business and each business, but the end goal is the same – to become a truly *green manufacturer*.

3.6. Sustainable vs. Green Manufacturing

Most manufacturing companies can't teleport from current business practices to a sustainable manufacturing process, so they often use "Green Manufacturing" as a guiding framework for improvements. For example, Green Manufacturing is a bridge to get a company from inefficient non-renewable energy usage to reducing energy consumption and switching to a renewable energy source.
As with any new initiative in the manufacturing industry, sustainability is faced with a fair amount of skepticism by many. One of the key issues with sustainability projects is that they require changing the current way of managing processes and require an initial investment.

In the 2014 report Profits With Purpose, McKinsey uncovers that almost half (48 percent) of survey participants admit that the pressure of short-term earnings performance is at odds with sustainability initiatives. This is still the case in many companies.

Finding a budget for projects that will pay off in, for example, 3 or 5 years is often hard to sell internally. That's why sustainability initiatives must be considered a long-term investment to ensure the company has reduced business risks and increased profitability. And this has been proven repeatedly – companies that invest in ESG (environmental, social, and governance) outperform the competition. But the ROI often comes only in months or years (depending on the project).

3.7. Social activity and culture

a) The role of the employer

Most people believe in the need to act sustainably to protect the environment. A frequent employee understands that small actions add up to collective impact; however human beings are surprisingly averse to change: we struggle to adapt our behaviors and to adopt new habits, even when we want to. Knowing and wanting isn't always enough. Smooth green change requires a clear understanding and acceptance among employees. That is why it is important to have a set of clear organizational core values that are communicated effectively and discussed with the employees so that they feel part of it. It is the commitment that an organization or a company makes to certain policies and actions "going green". It is not enough to state this in the mission statement, brand story or in marketing and promotional material. It is crucial that demonstrable actions are taken regularly so that the employees feel an individual and personal responsibility towards these values. This will ensure that they can evaluate their own attitudes towards these positive core values, and take pride in them. The involvement of employees in the "green change" process could increase employee awareness, accommodate their initial doubts and thus lead to increased consciousness for "green change". This could result in higher employee motivation to up-skill and thus a smoother implementation of the related new green procedures and technologies. Furthermore, employee participation can reduce the negative effects of green change on job quality. Employees need to know both why an action is important and how to do it. And hearing a message multiple times, in multiple ways, is often necessary for it to sink in.

Evidence shows that although "green change" definitely brings savings to business, it is not automatically beneficial for employees in terms of, for example, saved jobs, higher income or qualification, better health and safety, etc. The benefits resulting from "green change" are usually either not clearly communicated and thus not understood or not provided altogether. Lack or limited awareness of the benefits of "green change" and a lack of understanding of this process may lead to employee resistance to "green change", inadequate efforts and adverse attitudes towards the implementation of "green change" processes. Thus, benefits need not only be shared, but also clearly communicated.

Many organizations are adding Sustainability or Green Practices sections to their websites as a way to communicate their commitment to sustainability to their customers and employees as well. These web pages often explain the organizations' goals and current green practices. Another source of information may be Sustainability Reports. They can range from informal quarterly reports to more formal annual reports, which can be distributed to staff or the public by email, intranet or website.

Illustration: An enterprise's efforts, if not purely declarative, to protect the environment will only be effective if the change strategy chosen by the employers engages as much as possible the employees who will support the "go green" goals set by the employers and the "go green" actions chosen by the company.

Guiding questions: What measures should employers take to get as many employees as possible to the "go green" path chosen by the company?

b) The role of the employee

As they're deciding how to act, people look to both leaders and peers. If others they respect are doing or endorsing behaviors, people are likely to follow them. Group activities can be a way to make people feel that peers are also engaged. Green teams are instrumental in creating positive environmental change within an organization. Gaining the support of management for your green team is important to ensure the team has the resources it needs to be successful. Before meeting with management, prepare a strong value statement to articulate the green team's benefit to the organization. Value statement should define why being green is meaningful to the business and its employees. Not every green team will have management support via official status, budgets, or endorsed initiatives. Event an a volunteer status, a team can accomplish no-cost, easy actions such as setting up basic recycling and educating coworkers about behaviors that save energy and resources.

Establishing and prioritizing clear goals will keep the team focused and motivated, and provide the team, coworkers and management with a clear picture of what the team accomplishes. A good goal is specific, contains actions, and can be measured and accomplished in a reasonable timeframe. Prioritizing goals will help guide the direction of green team's activities and initiatives. That is why the team should have a simple sustainability plan that incorporates focus areas, baseline information, goals and prioritized items. Focus areas could include waste prevention, recycling, composting, water, energy, social sustainability, transportation, and

purchasing. These tactics may seem simple, but everyday habits and routines are very important for developing environmental habits at work.

There are many easy steps you can take to ensure both your green team and your coworkers are engaged and excited about the work you are doing. Engaging and energizing staff around green team initiatives is a key to green team's success – after all, it's coworkers who implement green team's ideas. So every time communication with staff (during staff meetings, employee blog or newsletters, annual sustainability event, discussion groups, etc.) is an opportunity to educate and engage. Even lunch time gatherings are a great way to raise awareness, engage and educate employees on sustainability issues. It is necessary to discuss the green initiatives, implemented green practices and success stories. It's also okay to share some upcoming projects, but they should be coupled with goals already attained.

Illustration: One or more groups of employees should come together in a company that has chosen the path of "greening" to promote sustainability in their daily behavior and actions and to try to involve as many colleagues as possible.

Guiding questions: What peer-pooling activities can a team of proactive employees do to create an environmentally friendly work culture within the company?

c) The role of the VET centers and high schools

Every school should encourage its students to try and make sense of the most pressing issues defining our times. The high demands placed on schools to help their students cope and succeed in an increasingly interconnected environment can only be met if education systems define new learning objectives based on a solid framework, and use different types of assessment to reflect on the effectiveness of their initiatives and teaching practices. In this context, PISA aims to provide a comprehensive overview of education systems' efforts to create learning environments that invite young people to understand the world beyond their immediate environment, interact with others with respect for their rights and dignity, and take action towards building sustainable and thriving communities. A fundamental goal of this work is to support evidence-based decisions on how to improve curricula, teaching, assessments and schools' responses to cultural diversity in order to prepare young people to become global citizens.

VET centers and high schools are users of buildings and engineering works. It is key importance, that future specialist form habits of behavior practically all day, not only theoretically during lectures and seminars.

It would be very helpful, if center or high school could demonstrate and involve everyone in own advanced waste sorting, energy use of building observation, photo voltaic elements, heat pomp, ventilation and recuperation, LED lighting system, indoor climate indicators registration, outdoor weather sensors in use observation. Would be much appropriated to organize participation in airtightness and thermovission test, preferably of problematic zones of own premises or building. All staff of VET center or high school shall follow internal rules on sustainable use of building and silently be an example of habits and behavior.

Finally, educating for global competence can help form new generations who care about global issues and engage in tackling social, political, economic and environmental challenges. The 2030 Agenda for Sustainable Development recognizes the critical role of education in reaching sustainability goals, calling on all countries "to ensure, by 2030, that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development" (*Target 4.7, Education 2030, Incheon Declaration and Framework for Action, page 20*).

Illustration: Already in a vocational or higher school, the "green" habits of a future specialist can be formed, which he would apply not only in the workplace, but also in his personal life.

Guiding questions: *By what means, methods or examples can an educational institution influence the formation and consolidation of a pupil's / student's "green" skills?*

d) The role of the initiatives of pupils and students

Every pupil and every student can take action for collective well-being and sustainable development. This dimension focuses on young people's role as active and responsible members of society, and refers to individuals' readiness to respond to a given local, global or intercultural issue or situation. This dimension recognizes that young people have multiple realms of influence ranging from personal and local to digital and global. Competent people create opportunities to take informed, reflective action and have their voices heard. Taking action may imply standing up for a schoolmate whose human dignity is in jeopardy, initiating a global media campaign at school, or disseminating a personal view point on the sustainability via social media. Globally competent people are engaged to improve living conditions in their own communities and also to build a more just, peaceful, inclusive and environmentally sustainable world.

Any initiative on sustainable use or small refurbishment (renovation) of center or school should be promoted and supported. It even can replace some lectures or trainings. Better, but not must it is in connection with future qualification.

Illustration: A group of students decides to initiate an environmental awareness campaign on the ways in which their school contributes to local and global waste and pollution. With support from their teachers, they arrange a series of talks on how to reduce waste and energy consumption. They also design and strategically distribute information posters that help guide students to make better choices when buying products and when disposing of waste. Furthermore, they collaborate with both student representatives and school administrators to introduce recycling bins and energy conservation strategies on the school premises.

Guiding questions: What tools, methods or examples can be used to ensure the greatest possible involvement of peers in pupils'/ students' sustainability initiatives?

3.8. Opportunities & Challenges of Sustainable Manufacturing

Sustainable manufacturing is a mindset, first and foremost. At the moment, there's no one globally approved definition of which activities are sustainable and which are not. To evaluate it, activities must be viewed and considered in the context of environmental, social, and governance aspects. For example, it might not be sustainable to source lithium for battery manufacturing, but using e-scooters or e-bikes is part of solving the social challenge of more efficient transportation in the cities.

In the context of manufacturing, a sustainable manufacturing process would in some way resemble how natural ecosystems work. A tree, for example, is consuming resources (nutrition from the soil, carbon dioxide, and sunlight) and is turning them into leaves, branches, and oxygen.

All the waste the tree has (e.g., leaves in the autumn) it throws on the ground where with the help of the natural ecosystem, turn into nutrition for the tree and other plants. As of now, we haven't seen a manufacturing plant that would have managed to achieve this sort of process.

A manufacturing plant that uses waste to create new materials while running on wind and solar energy would be an example of a sustainable manufacturing plant. It uses materials in the local environment and creates a product through the production process.

The changing climate is already, directly and indirectly, impacting how we live and work and will increasingly continue to do that. Resources and energy prices are increasing and facing unseen before scarcity with no promise of change in this trend. This makes companies think about efficient and sustainable operations more than ever before. For example, **some of our clients are monitoring their energy consumption in real-time in relation to their production output** to see how energy use can be made more efficient as waste is eliminated.

From a climate-related risk perspective, it's clear – companies that understand their business risks from climate change can adequately prepare to mitigate them.
Some examples of risks businesses see due to change are: **revenue loss** from customers hit by extreme weather events; **supply chain disruptions** due to floods, droughts, fires, or heat waves; **carbon tax impact** on the bottom line. And these are just a few of them, as each business is in its unique situation. All this creates a very good business reason for **remodeling factory floors and making them greener, more efficient, and sustainable**.

To recap, solutions vary from case to case. Still, many are looking at ways to source materials from local suppliers, implementing more responsible sourcing of raw materials, or a plan for shifting to low-carbon operations. By the end of the day, a company running sustainable operations can weather the storm (literally) while competitors' business is disrupted. **Nonetheless, sustainable manufacturing practices can help save money and resources in the process.**

4. METHODS OF TRAINING

The teaching of sustainability in a particular training program may be a separate embedded module or a component of each module of the program content. This theme can also be presented in combination, with a greater part of the program introductory module and information inserts related to the content of each subject module. However, a separate (preferably introductory) module of the program is recommended for a consistent and effective presentation of the topic.

Traditional approaches to training still offer a number of benefits and are commonly found in many schools and companies today. Here is a list of training methods from the traditional category that should be considered when choosing the best training techniques for pupils and students at school or employees in company:

1. **Classroom-Based Training** usually led by a teacher or qualified facilitator. Classroom learning takes place over one or more days in a physical venue on- or off-site. Groups of students or employees go through a series of presentation slides and activities, like case study assessments or information on environmental issues and requirements. The advantage of classroom-based training is that a group of students or employees can attain large amounts of knowledge at the same time. Unfortunately, most students and employees find this approach to training boring.

2. **Interactive Training** is one of the most effective training methods in the workplace. Interactive training actively involves learners in their own learning experience. This training can take the form of simulations, scenarios, role plays, quizzes or games. By practicing their new skills and applying them in realistic work scenarios, learners are not only more engaged but more likely to retain what they've learned, too. However, it can be time-consuming when done in person, especially when learners require regular feedback from a content expert.

3. With **On-The-Job Training**, not only are learners actively involved in learning, but they also participate in real activities that relate to their current or future job. This is one of the most effective training methods for succession planning. This type of training can result in rapid learning because learners are thrown into the proverbial deep end. This experience can be a little too stressful for some learners, let alone time-consuming, because of the frequent input required.

It is likely that sustainability module taught to pupils in schools should include classroom-based training and discussions in small groups with specific situations selected. Meanwhile, a combination of interactive training and on-the-job training would be more appropriate for apprentices and employees.

5. EXPECTED RESULTS AND ASSESSMENT

After completing the sustainability module, the successful candidate is expected to:

General Competence:

- be able to communicate about professional issues relevant to environmental protection and sustainable use of resources, on a common level;
- be able to apply acquired knowledge and skills within new work tasks and atypical situations;
- be able to read a job descriptions and instructions, understanding where it is appropriate to apply the knowledge and skills gained.

Knowledge:

- have general knowledge about environmental protection and sustainable use of resources;
- have general knowledge of the planning of environmental measures and the sustainable use of resources;
- have specialized knowledge about selected topics when dealing with different work tasks;
- have main qualification related knowledge of every mistake, failure, misuse influence to sustainability of manufacturing works.

Skills:

- be able to comment and make suggestions on how to improve the company's environmental practices and sustainable resource management strategy;
- be able to identify the necessary measures and develop a plan for the application of environmental measures and the sustainable use of resources in a specific task;
- be able to identify operational challenges/problems in environmental measures and the sustainable use of resources plan and to assert the measures and methods to resolve these;
- be able to select relevant measures and methods for approaching a given environmental problem;
- be able to choose and use relevant tools or technology in implementing environmental problem solution methods.

There is no need for a separate assessment of this module. However, sustainability control questions or tasks can be used to assess the knowledge and skills acquired through other modules in the curriculum.

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