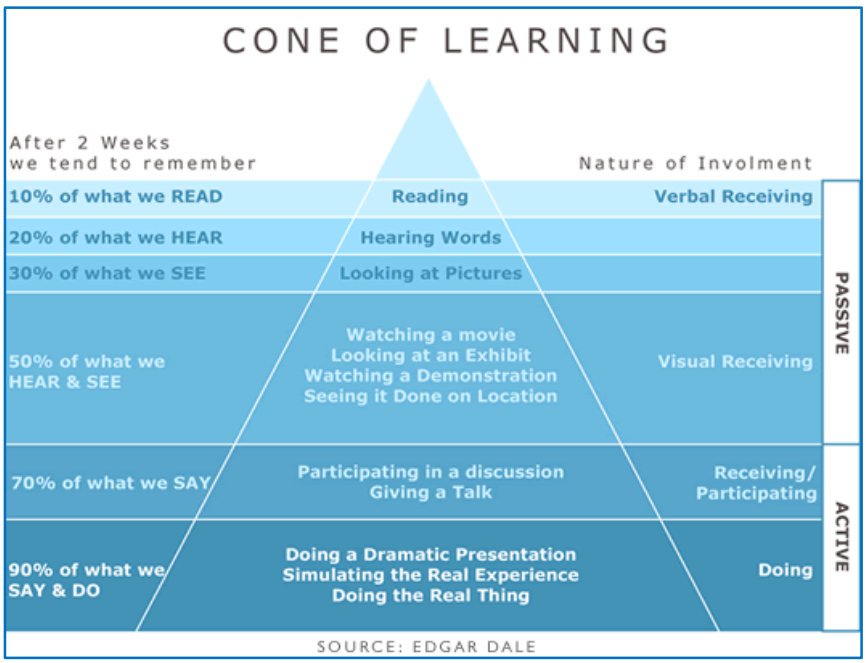
Virtual Maintenance Training

Introduction

The need for training and education does not require proof of relevance. Research shows that various training methods (e.g. traditional class room based training, online training, practice training) have their respective knowledge retention effectiveness. The closer to practical training, the more effective the knowledge transfer will become. The image below shows the various levels of knowledge retention, according to Edgar Dale.



Especially when it comes to maintaining large assets and costly equipment, training skills is of utmost importance!

Master-Apprentice-training

The Master-Apprentice training principle is based on the experience of the master, transferring knowledge to the apprentice in real practice. According to the Cone of Learning the knowledge retention goes up to 90% which makes this method extremely efficient.

But there is a downside to this training method. It is the most expensive since it requires one-on-one training between the master (teacher) and the apprentice (trainee). Therefore, this training method is most often used in areas where practical skills are required. Because of the above the masters' knowledge is most likely spread over multiple simultaneous trainees limiting the one-on-one knowledge transfer by the amount of simultaneous trainees.

Limitations of practical training

The human element of the Master-Apprentice training principle is only one of various limitations that this efficient knowledge transfer method faces. Also (personal) safety, availability of training equipment, planning, (recurring) cost are limitations that come with training in practice.

(Personal) safety

Training equipment and assets can be large in size or heavy in weight. Also equipment might be confined, holding hazardous energy e.g. toxic substances, electric energy, heat, extreme cold or pressure or on height or depth. Therefore, (personal) safety might be an issue to create a safe training environment in real life.

Availability of training equipment

Not only safety but also availability of an asset can be a major challenge for real practical training. The asset might be on a large distance from the trainee or always in use because of production. In area's that run 24/7 assets and equipment cannot be used for training, so (limited) substitutes might be in use.

Planning

Equipment and "master" knowledge is required for effective practical training. This requires planning, and therefore the training is limited to that. Research shows that the effectiveness of knowledge transfer through repetition is much higher than through a single (planned) training session.

(Recurring) cost

Training is often seen as a cost to the organization, where in fact it should be a long term investment. Cost for training can be distributed over various categories. First, there is the cost of personal unavailability. The trainee will not be available for production which is a cost to the organization. Secondly, there is the cost of the training asset. Whether this is the unavailability of an asset for training, or a separate training device. Thirdly, there is the cost of failure. Efficient training enables the trainee to (safely) make mistakes). Mistakes might turn into a cost since making mistakes might damage equipment or the training arena and require repair or maintenance.

Overcoming training challenges

Despite the training challenges in real practical environments, skill training and rehearsal in practice is of utmost importance for effective knowledge transfer.

But how to overcome the challenges and issues? The answer is **Virtual Maintenance Training!**

The world of simulation and gaming is booming and the balance between price and quality is getting better with every innovation in technology. Referring to the Cone of Learning the effectiveness of Virtual Maintenance Training (or simulated training) is equal to skill training in real life. Please note that simulated training does not replace real life training, but can create a safe, realistic and immersive training environment for use as pre-practice training. Simulated training raises the understanding of safety, processes and procedures related to the actual asset. Therefore, the level of entry into the practical training will be much higher enabling a better understanding and awareness in the physical training environment. The scarce availability of the physical training environment will be more effective for training and the effectiveness of the knowledge transfer will be higher in level of understanding and quality of knowledge. Also simulated training enables the trainee to learn more in less time since the virtual environment is more efficient that the real environment. Elements that are hard to learn in real practice can easily be integrated into the virtual world e.g. life threatening situations, danger, time pressure and the effect of making mistakes.

Virtual Maintenance Training devices contain three important levels of knowledge:

1. 3-dimensional virtual replication of the real world training environment (3D model)
2. The interaction with the 3D model process resembling the real world
3. The learning process and training scenario(s)

Virtual Maintenance Training 2.0

Although simulated training seems to be the holy grail for replacing or adding to skill training, the development of Virtual Maintenance Training Simulators is still very costly and time consuming. Having said that, not only the development but also updating and upgrading these virtual simulation devices can be expensive. Therefore, BlueTea has developed a concept for development of Virtual Maintenance Trainers called Virtual Maintenance Training 2.0.

Traditionally all 3 levels of knowledge are combined within the virtual training device (application) and development/changes require specific knowledge from software developers and 3D engineers. By separating these 3 levels of knowledge into various physical application levels, flexibility and reuse of data is raised and development of training is spread over various experts. The 3D model still requires software developers and 3D engineers, but the interaction and process requires knowledge from the asset expert and the learning process and training scenarios require training experts. These knowledge areas will change over time and need to be revised accordingly.

From trainee perspective the required knowledge might vary according to level and use. A mechanical engineer might require other knowledge than a system operator. The flexibility created in Virtual Maintenance Training 2.0 enables the leveling of knowledge on a per user base.

Simulated training and Virtual Maintenance Training is typically deployed in a distributed model using computers (e.g. Windows and OSX devices) and mobile devices (e.g. Android and iOS tablets and SmartPhones). This distribution model makes it easy to use at any time and location. By delivering the content based on the user need flexibility is maintained and the focus is on knowledge development on a per user basis.

Interactive documentation

The use of virtual or simulated worlds stretches further than training itself. How often does it happen that training documentation can be reused in the field for supporting the engineer on the job? Simulated training devices and Virtual Maintenance Trainers enable the reuse of the exact same knowledge for training and for on the job use. This effect can only be established when the virtual training device is location independent and can interact with the real device (using technology like Augmented Reality).

General, this is a positive side effect of creating virtual training devices when the knowledge is split into various content management levels as described in the section Virtual Maintenance Training 2.0.

Adding gaming and technology

When moving into future technological development, techniques like gaming and technology like Virtual Reality glasses, Augmented Reality devices and upcoming gear like Microsoft Hololens® will enter the simulated training and interactive documentation arena as well. Especially the use of gaming can raise the level over knowledge transfer even further. This is done through the principles of “engagement” and “interaction”.

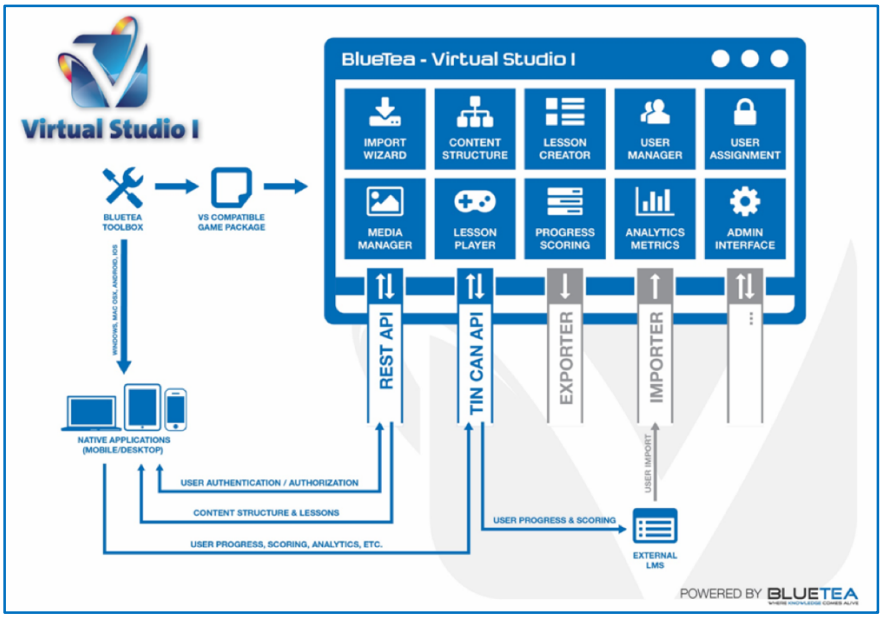
Advantages of Simulated Training

Summarizing the advantages of Virtual Maintenance Training:

- Safe training environment
- Unlimited training in time and experience
- Learn by doing, allowing for mistakes to happen
- More knowledge transfer in less time (efficient)
- Simulation extremely close to real practice but still safe
- Simulate danger, life threatening situations time pressure and cause-effect
- Flexible in process and knowledge distribution
- Distributed and game based training
- Multi user training
- Part-task training enabled
- Version control
- Reuse of data for training (various levels) and documentation
- Add technology (e.g. Virtual Reality, Augmented Reality, etc.) when it enhances

Content creation process using BlueTea Virtual Studio

For creating training content based on the Virtual Maintenance Training 2.0 principles a few steps have to be followed. These steps are displayed below and are based on the capabilities of BlueTea Virtual Studio. The images are taken from a virtual reality safety training, to illustrate the steps.



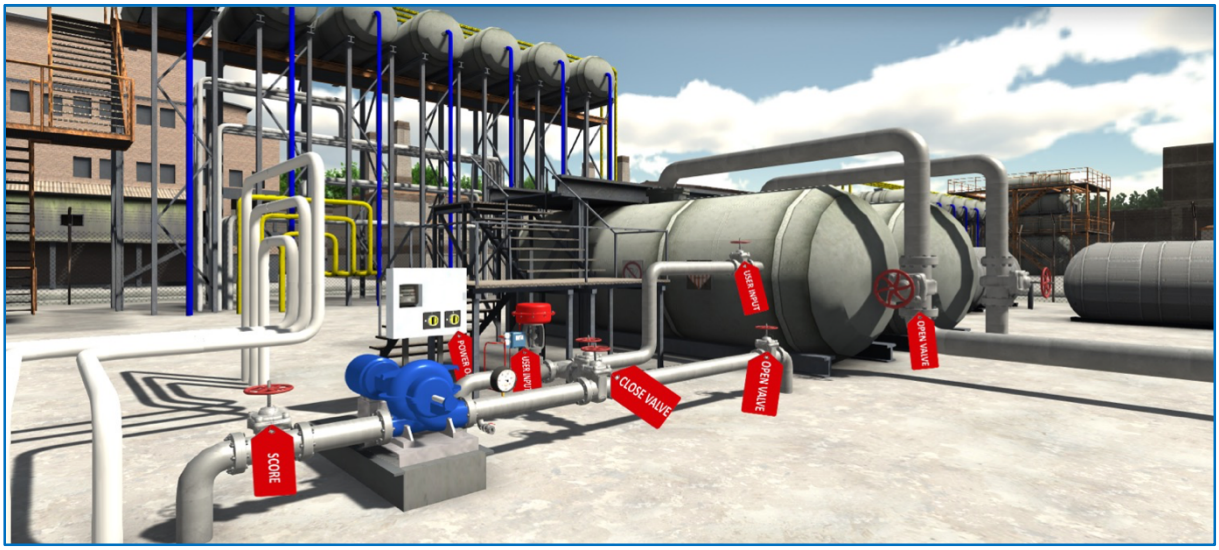
Step 1: Create 3D realistic virtual world

The basis of each Virtual Maintenance Training application is the use of a realistic 3D environment. This is the virtual training environment that the trainee or engineer in the field will interact with.

This world can be created via software engineering or 3D artists, but can also be imported into the Virtual Studio environment using solid state CAD (Computer Aided Design) models. These models will then be altered into a realistic looking 3D environment by adding textures and shadings.

Step 2: Adding interaction

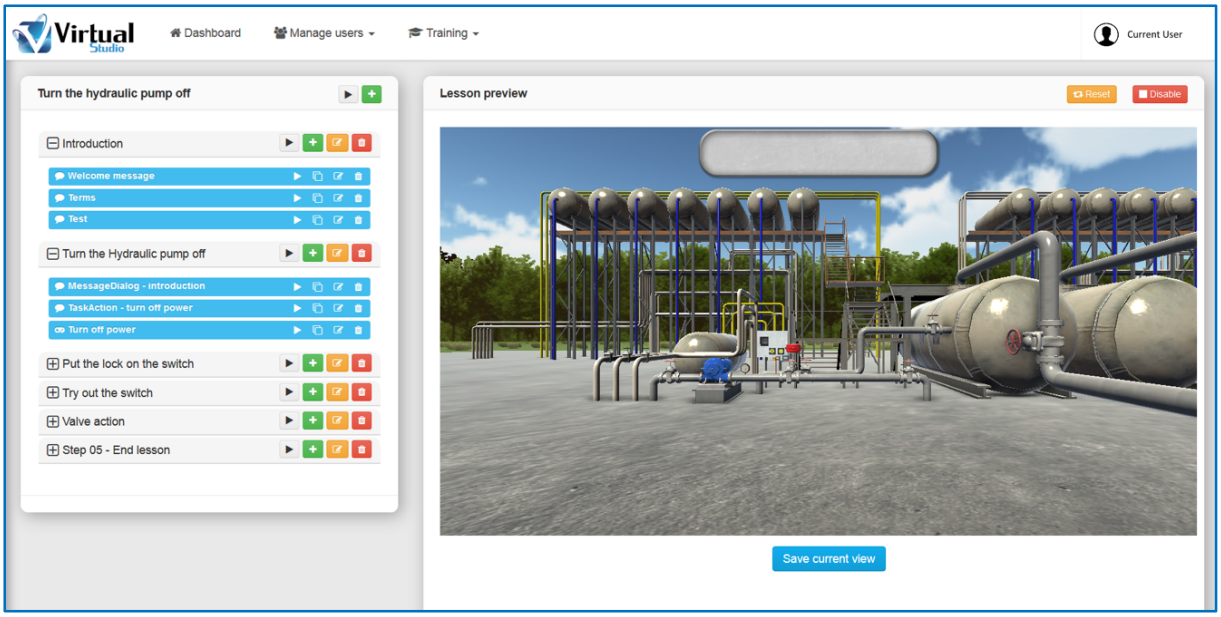
The base model that has been loaded via step 1 holds no interaction or recognizable elements. Via Scrum based development approach software engineers, 3D engineers and subject matter experts add this interaction to the model by labeling the separate elements in the virtual world.



Step 3: Creating the training/documentation process

After tagging the model the 3D world becomes interactive and can be enriched with the training process on a per user basis. Subject Matter Experts and/or Training Developers can use the easy editing platform of Virtual Studio for creating the training process and make the trainee interact with the virtual model.

Based on the complexity the training can be organized in chapters and lessons. This also enables the reuse of the content for future use in the field.



Step 4: Deploy

After creating the initial training, deployment to any device is arranged. Using the versioning capabilities of Virtual Studio step 3 and step 4 can be repeated endlessly in deploying new content based on user profiles and based on part task training needs.