By Paul Hull

Simulators Go Far Beyond Mere Games

Today's training techniques can be fun. They also work very well and save money.

Some people look at simulators and see them as nothing but entertainment. Wrong! Having seen all those flashing, bright, impossibly active video games that allegedly simulate real life situations in all their destructive enjoyment, we cannot be blamed for thinking that everything that claims to imitate real life situations will be as juvenile and unreal as the games touted on television. "What do they do? Show them how to destroy my excavators?" asked one skeptical manager when I mentioned simulator programs for his trainee operators. The opposite, in fact, is true. Safety, reliability, and a reduction of production losses are keys to the motives behind the use of simulators.

Simulators are not a new idea. They have been used successfully for years as training systems for pilots of planes and helicopters, where they reproduce situations in flight with none of the risks for the trainee that would exist if all the turns, twists, and changes of speed were attempted in real planes several thousand feet above the ground. They are fairly new for training operators of heavy equipment, with mining companies being the leaders so far in this arena.

As you may expect, the momentum for training good operators comes from the top manufacturers of today's earthmoving machines and vehicles. "The mission of Caterpillar Equipment Training Solutions is to help Cat equipment users get the maximum return on investment through the delivery of operator training services," says this manufacturer. "Caterpillar now offers new e-learning opportunities, as well as instructor-led, simulator-based classroom and in-the-iron programs." Not all manufacturers offer simulator programs, but there seems to be enough praise for existing programs that we can expect more in the not-so-distant future. "We think they are excellent, but we haven't got them yet," can be given as a typical response from a representative of a leading manufacturer without simulator training offered. "Everyone thinks they are great, and they work well, but we have no plans to introduce them yet for our range of machines." The simulators themselves seem to be designed and made by expert outside sources working with the manufacturers to

Immersive Technologies

Simulators can be excellent as learning devices and as a means for identifying an operator's personal characteristics and style of driving.

adapt them to particular machines and types of sites. The investment in simulators, then, comes from both manufacturers and customers, and the years of 2008 and 2009 may not seem the best of times in which to introduce innovations; on the other hand, these may be the right times for planning future developments.

Manufacturers encourage good training because they know that their machines work best when used correctly. Whatever some operators and drivers may claim, most inept and inefficient operation is caused by inept and inefficient operators. And it's not that they're stupid. "For too many years we have assumed that our new hires—and our older employees—know all about new techniques and the best way to run machines," says Robbie Dixon, an excavator operator I met in Oregon last summer. "We assume that everybody knows what the manufacturers have changed, don't we? How could we know that?" Simulators can be an ideal and fast way to bring your better employees up to the standard you require.

Who Can Benefit?

Working with industry specialists Oryx Simulations, Volvo has launched two high-reality simulators that allow wheel loader and excavator operators of all skill levels to practice everyday work-site scenarios in a safe environment. That phrase "of all skill levels" is important. Manufacturers point out that training should not be, and is not, restricted to beginners. For some of the programs, the operator must already have good experience to qualify for enhanced skills.

With Volvo's simulators, the virtual scenarios are developed and adapted to match the needs of the customer and operator. Expert 3D artists can even replicate a customer's real working environment if that is what is most appropriate for the training. Normal vehicle characteristics (such as the sound of the engine and the hydraulic power) are reproduced faithfully by Volvo and its partners. The use of the same controls that are fitted to actual Volvo machines reinforces the realism of the simulator sessions and operators sit in the simulator cab as if they were in a real machine on site. The simulator user can even feel that he or she is bouncing over uneven ground. Yes, such simulators are real life, not mimicking games. If you drive the expensive equipment off the road or into the pit, the only damage is to your pride. For the Volvo training, instructors are on hand to advise the operators on how to improve their handling skills and correct any mistakes, without the risk of costly machine damage. Instant evaluation and feedback show incorrect performances and allow training operators to learn more quickly.

It is worth noting here that research has shown that, in normal working conditions, the efficiency of vehicle and machine operators can vary as much as 40%. That's why the training is helpful for both inexperienced operators and old hands. No contractor will be surprised to learn that some operators who boast of their long experience and natural ability may, in fact, be the least efficient. It's like the car driver you know who brags that he has been driving since he was a little boy on the farm—and driving badly, with tickets and wrecks from way back to prove it. The challenges of the simulators can be adapted to the skill level of the operators, so they are not simply playing at jobs but learning how to cope with possible difficulties.

Simulators are not a complete training system in themselves. Nobody will believe that a few hours with a simulator will produce a qualified operator, but it can produce an operator who has learned dangerous procedures without any real danger involved. Companies who offer training programs with some of the program using a simulator (such as one made by Immersive Technologies, the kind that Komatsu uses) set up a complete training program. The instructors are well qualified in earthmoving machine use, and the equipment is well proven. You might select a three-day basic training program for, say, three trainees, or a more intense program for five days, with 17 hours of hands-on simulator time and 30 hours of classroom instruction. Such training is not a convenient, easy shortcut for lazy students. The simulators used for such programs are transported in a 20-foot sea container (by air, ground, or water).

Not all Simulators Are Manufacturer-Specific

What is the best way to train operators to handle dangerous and hazardous situations? While many contractors believe you cannot have better experience than at an actual site, with an actual machine, facing actual challenges, it may be wiser to have your novice operators learn where the dangers are exactly like real dangers but hold no threat of injury or machine damage. With a simulator such as those produced today, the operator will experience exactly how the machine would react in a broad range of conditions and situations. For example, what happens when a loader is overloaded and tilts forwards? Would it be better for your new employee to do this at your job site (with considerable risk to person, property, and

Simlog

This is the simulator view the trainee has when loading a truck from a wheel loader.

machine) or to know, feel, and understand what could happen if he overloaded the loader at that job site?

"The simulators have several major advantages," observes Arvid Rinaldo, global market communications manager for Volvo's hauler and loader business line. He has been involved directly in the company's simulator project since its inception. "Although they will never replace real experience out in the workplace, they can dramatically and rapidly improve an operator's performance and skill levels, because he can keep working at a difficult task until he gets it right, whereas, in a real situation, he may not get that chance to practice and perfect his technique." "Another important factor that shouldn't be overlooked," adds Jonas Thoursie, marketing director at Volvo, "is that the simulator is environmentally friendly. It has virtually no negative impact at all."

The most obvious advantage for the operator (and the owner of the equipment) is that the simulator work is done in a totally safe environment, with the knowledge that mistakes won't end up in injury or damage. For customers—owners of machines—another great benefit is that the machines do not have to come out of operation and their real work mode for operator training, so there are less costs like downtime, wasted time for highly paid operators, and fuel consumption. Training may be perceived as strictly nonproductive work, and you may not want you highest-paid employees doing it. "In essence, the costs and risks associated with the first 40 hours of operator training are taken away from the real excavator and achieved at the simulator cheaply and safely in the classroom," notes Mike Keffer at Simlog, world leaders in simulator design and production.

The simulators associated with the big manufacturers like Caterpillar, Volvo, and Komatsu include cabs that reproduce the actual interior of the manufacturer's cabs. There are also simulators that you can use with your PC. Considerably less expensive, they do not have customized cabs with them, but their purpose is different. Simlog is a leading provider of these PC-related simulators, which are also used by equipment manufacturers.

"In comparison with the turnkey simulators from Volvo, Komatsu, and others that focus on the manufacturer's own equipment specifics, and less on instructional design for development of operator skills, our simulators work on those core skills that are common to operating any excavator or any wheel loader from any manufacturer, anywhere in the world," comments Mike Keffer of Simlog. "Students start off training at a Simlog simulator for, say, their first 40 hours of practical training, to build up core skills or muscle memory, starting with easy tasks like left-stick–right-stick manipulation, and then getting progressively more difficult with tasks like controlling the boom and bucket, digging a trench, and loading a truck."

Vista Training Inc., based in Waterford, WI, uses Simlog simulators and has more than 10,000 customers who have used its training products and services. Most appropriate to us may be the simulator programs for hydraulic excavator and wheel loader. Apart from training existing employees, the successful applications have included job interviews, to assess if a job applicant has the innate ability to run the equipment we use every day.

When simulator programs are used, the instructor does not evaluate the user by standing there and watching over his shoulder, as an instructor may do at a job site. (And we all know how great it is to try a new task with an expert peering over your shoulder!) Without interfering or allowing any damage, the simulation software measures how well a user succeeds in more than 15 ways; it monitors and records the stick angle, bucket fill, precision in trenching applications, execution time for the job, and useful information like that. The results are saved, of course.

Komatsu

Yes, you can simulate the problems faced by a dozer operator on steep slopes and poor terrain.

"We provide 12 simulation modules of increasing difficulty," observes Terry Houlihy for Vista-Training. "And, remember, this is a portable system. You can take it where you need it, wherever you have a PC available. For excavator trainees, we take you from the basics of boom and carrier operation to trenching and loading trucks, all the techniques a good operator needs to know. It is a safe and most cost-effective way to help you when you want to select new trainees efficiently, bring new operators up to your standards, and qualify your new hires reliably. When you think that even so-called small accidents at the site, due to inexperience or improper training, can cost thousands of dollars in repair, replacement parts and downtime, the cost of a personal simulation training program, about $4,500 total, makes a lot of sense."

Using the personal simulator for wheel loader training is similar. You connect off-the-shelf controls, install the simulation software into your PC, and go straight to developing your skills. You will have virtual digging and loading a simulated off-highway truck. You start by choosing either steering wheel or stick steering, and the program measures your ability in areas like loader positioning, filling the bucket, execution time, and productivity.

Levels of Learning, Continuing Development

A point emphasized by those who have experience of simulator-based training is that it's something to which you can return again and again. If one of its principal benefits is that

John Francis

Some contractors and colleges have public land for practice ... but might have to rent the machine.

it can help detect (and reject) those who are applying for your operator positions but have no aptitude for them, another is that it is a resource for your employees as they undertake new tasks or advanced projects. Caterpillar's e-Learning curriculum, for example, offers many tips and techniques on safety, machine inspection, and operation. That is not merely Machine 101, is it? It means that, if you perceive problems or difficulties for your employees in certain tasks, you can give them some time with the appropriate simulator program to remove the obstacles and build confidence. Workers can undertake learning when they need it, where they need it, and in a format that is straightforward for everybody, regardless of size, strength, gender, or those communication skills that are often weak or ignored at the job site.

The most common objection to simulators will be that there is nothing like real-life experience in the field, even if it is potentially dangerous to machine and operator. That is true. If you are training by using a program on a PC, you will not experience the bumping and movement of life on a real machine over uneven ground. If you use a Volvo Care Cab for your simulator training, you will feel those movements, thanks to its hydraulic motion platform, and this means that the operator can be taught all levels of operation from basic maneuvers to complex operations required with rough terrain. As you would expect, a simulator (like Volvo's or a model from Immersive Technologies) that can simulate everything including the vibrations and bumps will cost more than one that is based on a PC program. The jury is still out, however, on how important it is to feel those bumps and, just as when choosing a personal vehicle or an excavator, it depends on what you want and what you can afford for your particular situation. The bigger types, as opposed to those successful portable ones where a PC is used, are usually leased by the manufacturer, often to an authorized training school that has the right teaching experience and qualifications, and you would arrange for training sessions that include simulator use as well as more traditional instruction. To repeat, simulators can be a useful part of a good training program.

What if some of your applicants already had training for the job they want? That may sound like a silly question when our education system is supposed to train people for work but we know that there are few education courses of direct, practical help to heavy equipment operators. We have read about one, however, that sounds most interesting and relevant in today's time when laid-off employees will have to retrain, perhaps for important construction jobs to help improve our infrastructure.

There was one story about the use of simulators that really grabbed my attention. It took place in a county where manufacturing job losses had been extensive. A community college, helped enthusiastically by a local user of earthmoving equipment, offered a course in heavy equipment operation to those who were looking to retrain for new jobs—jobs that were often better paying than the ones they had lost. To match the enthusiasm of those looking for new skills in construction was the local need for skilled workers in construction. It struck me that there could be many counties where unemployment has reared its ugly head over the last few months and the willingness of our community colleges to provide courses to help those unemployed in a practical way could turn despair into confidence and success again. One of the worst feelings of the unemployed worker is that it was his or her fault, when many of those who lost jobs in, say, manufacturing, are skilled workers, motivated workers. They happened to be in the wrong sector of industry. Construction work is suffering, too, and people have lost their jobs, but this situation will change and get better, and contractors will be looking for skilled operators again. When some of the proposed rebuilding of our national infrastructure actually happens, there will be many well-paid jobs for skilled operators of heavy equipment, much of it in the excavation and grading arenas. Does your local college help to satisfy your needs for trained employees? The equipment used in addition to the simulators were two Caterpillar machines donated by a local Caterpillar dealer from its rental fleet. The site used for the actual machine operation is ground owned by the county.

Most disappointing for me when I talked to operators and contractors about simulators used for training was not only that too many of them had never used a simulator, but also that they had never heard of them.

Those who have attended such trade shows as CONEXPO had seen simulators, even had a turn on one, but there is a long way to go. It must have been the same when many technologies and techniques we accept as standard today were first introduced. "They're just a gimmick from some company that wants to sell more to us" or "The people who recommend these inventions ought to try a few months in the field" or "Technology, technology, we've done well without it for 20 years so why would we want it now?" are some of the comments I've heard. Similar comments were made about computers and new telephone technologies when they were introduced. At some stage we have to look at, evaluate, and test new technologies that could save us money, prevent accidents, and give momentum to the businesses we have started and grown.

Caterpillar

Caterpillar's classroom training programs now include instructor-led, simulator-based sessions.

Volvo

This view shows the accurate details of a simulator cab in a training session.

Methods Are Complementary, not Competitive

Komatsu has an excellent training ground in Georgia, where operators can learn new skills and familiarize themselves with new techniques in earthmoving equipment. Komatsu customers have also used simulators to improve skills. So far, Komatsu's experience has been with mining customers where drivers of huge trucks and operators of matching huge loaders learn how to be most efficient. The simulators used are designed and made by Immersive Technologies in partnership with Komatsu. "When you are using the simulator, you feel you are actually running the real vehicle," notes Erik Wilde, vice president of product marketing and planning for Komatsu. The cab you are in is a Komatsu cab, used by Immersive Technologies to produce the simulated action.

"The [Immersive Technologies] simulator has helped in identifying the different character sets of an operator," observes Bob Huculak, training manager at Nuna Training Technologies in Canada. "From my experience in using our simulator, I can use the results of a training session to evaluate the personal characteristics of an operator. Is the operator a risk taker, or does he remain cool and collected during an emergency or poor driving conditions? Productivity has improved because the operator uses the machine closer to the recommendations of the manufacturer. Cycle time has improved. Downtime is reduced because the operator reacts quickly to machine problems."

John Deere has a comprehensive operator training program, with three levels recommended. The first level is "Level-1 Online Courses," with the virtual training simulator as Level 2. The third level is "Instructor Led Training." For Level 2, with a John Deere Excavator Simulator, the user will learn operator techniques and safe operation in a virtual job site. There are eight challenging, real-world tasks, including an overview of operator controls, end-of-day parking, placement for trenching, loading a truck from a bench, digging a level trench, setting a trench box, picking and placing pipe, and loading onto a trailer for transportation. In addition to those everyday tasks there are simulations for more than 20 different safety measures and violations throughout all eight defined tasks.

The simulator can be carried in the back of an SUV from site to site, and it includes replica foot pedals, joysticks, and simulator software, all for under $10,000. You can choose between SAE-excavator controls or John Deere ISO-Backhoe controls. Perhaps most useful of all, the user receives immediate feedback after each task, comparing the student's performance with that of a skilled operator. The actions and performance during simulator training at John Deere can be scored against a budget so that you can see projected monthly profits or operating costs based on the performance. John Deere has introduced a motor grader simulator and will present a 4WD Loader simulator this summer. Reports from users indicate that using the simulator during operator training can reduce fuel consumption drastically, prevent equipment damage and keep operating costs down. These are not, then, simply games to amuse but training techniques that bring efficiency to operators and profit to equipment owners who choose to have their new hires and experienced operators include simulator training in their ongoing education.

Simulators, then, are gaining acceptance as a practical and cost-effective way to ensure that your operators are the best you can have. They are not the whole solution, they are not the entire training program, but they bring worthwhile benefits, especially to those who cannot afford to have current equipment and operators take time from their productive efforts to help less capable employees. You can hire the complete system, where equipment and instructors visit your place of business to educate, or you can use PC-based programs that may provide as much simulated help as you need. Simulators are worth investigating. They are examples of another technology that can assist contractors in their nonstop efforts to be busy and profitable. If you agree that training and technology are essential components our future success in earthmoving, you must look at simulators and how they help. GX

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