

Coordinated Operator Training

Haulage and Loading Conference 2017



Session Outline

- What is Simulation Training?
- Some History
- Advantages of Simulation Training
- Simulation Training in the Mining Industry
- Simulator Applications in the Mining Industry
- Traditional Approach
- Coordinated Training Approach
- Results



What is Simulation Training?



History of Simulation



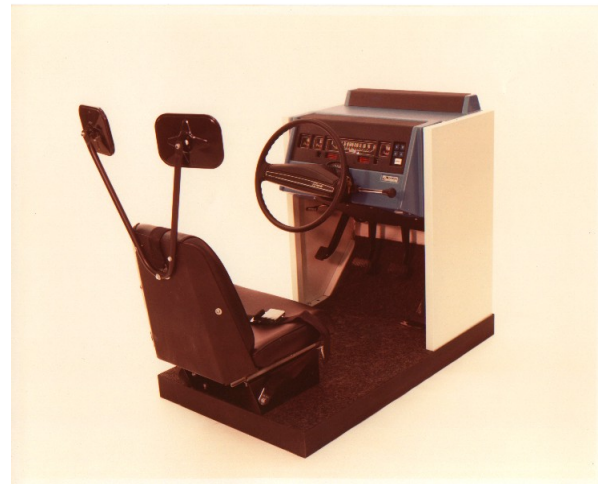
Edwin A. Link
(Father of Simulation)



In 1928, Edwin A. Link left his father's organ building business in Binghamton, NY to begin work on a "pilot trainer." In 1931 he received a patent on his "pilot maker" training device.



The Development of Driving Simulators Began in the 1950's



History of Simulation



Moving to
the 1970's



President Reagan Learns To Drive



Advantages of Simulation Training

Screening New Employees
Familiarization with equipment
Basic Training
Refresher Training
Evaluation and Record Keeping
Transfer to new types of equipment
Practicing Skills
Reducing risks
Learning rules
Compliance to standards
Accident evaluation
Research and development
Reducing damage and wear to actual equipment
Saving Money



Simulation Training in the Mining Industry



Simulator Applications in the Mining Industry

Simulator usage is focused on several areas including:

- Safety
 - Basic Skills Training
 - Equipment type Training
 - Emergency Training
- Productivity
 - New Operator Training
 - Equipment familiarization
 - Refresher Training for experienced Operators
 - Efficiency in task performances
- Cost Management
 - Maximizes use of actual mine equipment
 - Reduces wear on equipment
 - Reduces operator misuse
 - Improves profit margins of mining companies



Advantages and Benefits of Training Simulation in the Mining Industry

- Safety
 - Increased Safety Awareness
 - Practice emergency response in a safe environment
 - No risk to operator or damage to machine
- Reduction in non-productive equipment usage
 - Simulator training replaces a majority of Truck/Shovel time
 - Reduces machines misuse
 - Reduction of maintenance and fuel costs
- Operator Evaluation
 - Provides candidate selection
 - Simulators can quantify and evaluate performance
 - Provides problem identification and solutions to new and experienced drivers and operators
- Training Curriculum
 - Can provide shorter training periods to improve learning
 - Exposure to multiple training scenario's from basics to complex
 - Can implement and enforce best practices in the workforce
 - Motivates the employee



Training Evolution in the Mining Industry

1980,s

- MSHA Task Training
 - Varied by mine or project
 - Focused with new task training
 - Lead by Safety department

1990's

- Standardized
 - More structured program
 - Introduction of formal testing

2010's

- Targeted
 - Matured to include adult learning principles
 - Incorporated simulation into training environment



Traditional Simulator Training Approach

- One Simulator – perhaps multiple modules – driving or operator positions
- One Instructor to driver/operator
- Two simulators to an instructor, independently controlled, occasionally networked for limited integrated training



Coordinated Training Approach

- Up to six simulators, using one Instructor, each can be independently operated or all fully integrated
- Two or more Haul Trucks, a Shovel, a scraper and other vehicles can all be integrated into one scenario
- The Instructor can have multiple views and communicate with each trainee driver/operator



Advantages of Coordinated Training

- Operators can properly communicate with each other as in the real world
- Integrated exercises accurately replicate normal mine operations
- The same digging/excavating operations can be observed by two or more operators/drivers
- Positioning and Loading Operations can be made easier
- Dual Side Loading Operations can be trained
- Emergencies can be handled as a team



-by-side or Holistic Training - something intimately inter-connected and explicable only by reference to the

Approach to Coordinated Training – New Technology Available

- Using the latest technology simulators can now provide both the very high resolution synthetic visual scene and advanced physics model
 - The synthetic visual scene or database can be created with a very tight mesh and overlaid with extremely high resolution texture
 - Using an advanced physical model, the mesh can be tessellated in real time to create deformations or changes in the rock or other material
 - Gravitational and rotational forces are computed
 - Tires and vehicle suspension is modeled



Approach to Coordinated Training – New Technology Available, cont.

- Rock and Soil Deformations
 - Enable the Excavator or Shovel operator to dig and remove product
 - These products have physical volumes, weights and masses – hence can be measured
 - Can be moved into a truck or dumped onto ground
 - The properties of the product is known and effected by the operation
 - As a shovel load is placed in the truck the volume and weight is transferred
 - Any spillage outside the truck is formed on the ground and is not computed as weight in the truck



Approach to Coordinated Training – New Technology Available, cont.

- Accurate Truck Loading
 - Previous methods of “visual effects” and animations are now replaced by a physics models computing accurate loading
 - The loading more closely represents real-world operations
 - Accurate “Particle simulation” provides random particles of different sizes/weights being moved
 - Spotting Times are improved
 - Efficient loading cycles and managed loading is achieved
 - Improperly and unbalanced loads can be simulated
 - Effects truck driving and performance
 - Wear on tires etc.



Approach to Coordinated Training – New Technology Available, cont.

- Accurate Shovel Operation
 - Dig areas and Loading zones can now have real-world looking formations that change with operations
 - As the shovel bucket enters the rock face the forces change based on rock/soil type and density
 - Rocks can spill and move as the shovel operator digs the face
 - Weights and volumes in the bucket affect the shovel handling
 - Bucket fill factors are properly computed
 - Proper computation of the rock/soil is made to provide pouring, settling and accurate forming



Approach to Coordinated Training – New Technology Available, cont.

- Dig Face Operations
 - Very realistic training can be provided at the dig face for both the shovel operator, haul truck driver and other support vehicles such as the scraper and grader
 - Proper Positioning of the shovel in the dig face
 - Accurate positioning of the Haul Truck(s), either side, or both sides of the shovel
 - Maximum use of the scraper to remove spillage and rocks from the area that can cause tire damage etc.
 - All fully coordinated for maximum efficiency



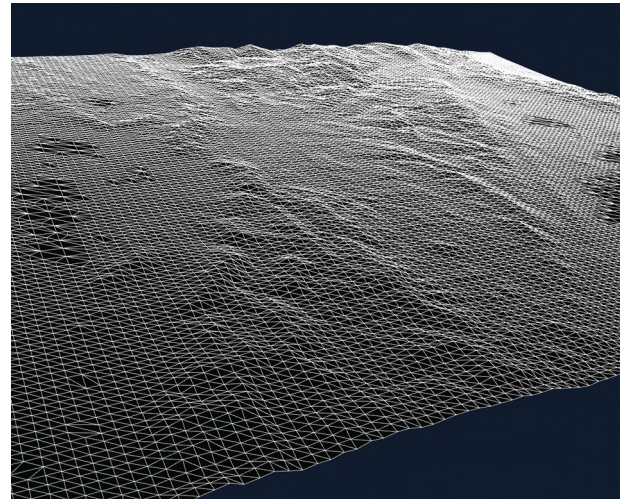
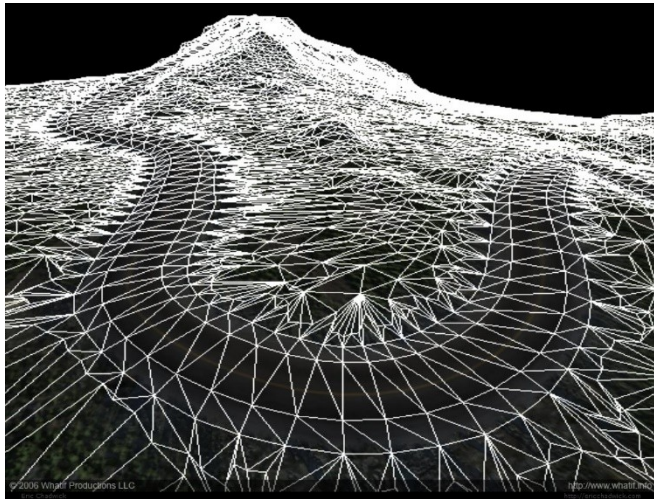
Approach to Coordinated Training – New Technology Available, cont.

- Accurate Truck Driving and Dumping
 - A correctly loaded truck provides safety and efficiency to the highwall dump or at the Crusher
 - Lowers fuel usage
 - Imbalanced loads and overloading are accurately simulated
 - Dumping weights, volume and effects are computed



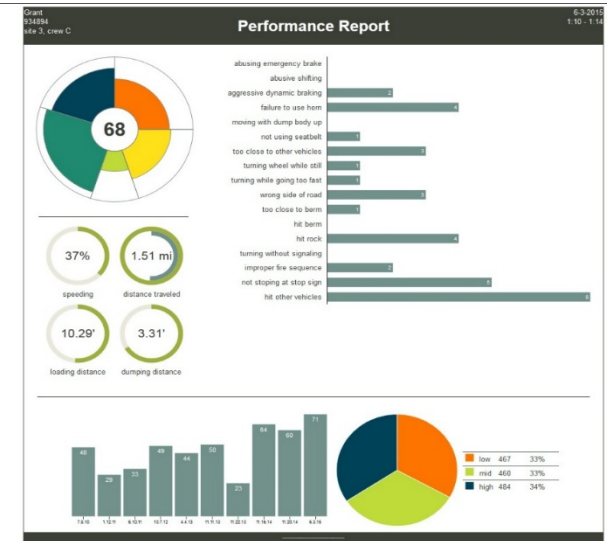
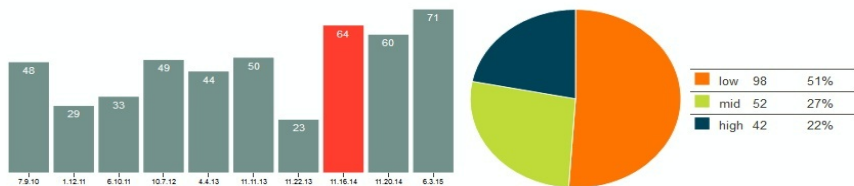
Approach to Coordinated Training – New Technology Available, cont.

- Dynamic, deformable Terrain and Soil Modeling
 - Changes in terrain affect both the Shovel Operator and Haul Truck driver



Approach to Coordinated Training – New Technology Available, cont.

- Real Time Scoring can track Performance and provide instant feedback for load positioning, load size, truck positioning, shovel positioning, etc.
- Provides instant feedback to driver and operator
- Allows for operator assessment and comparison to
 - Previous results
 - Real world results
 - Ideal results
 - Other drivers and operators
 - Mining companies and see the effect on the “bottom line”



Approach to Coordinated Training – New Technology Available, cont.

- Future Enhancements
 - Gaming engines are improving both the software and hardware of the simulation product
 - Improved Graphic Card Technology
 - Lower Costs
 - Higher Performance
 - Improved software physics models
 - Greater performance
 - More complex algorithms
 - Advanced hand held devices and wireless protocols are improving the GUI, (Graphical User Interfaces), enabling the Instructor/Trainer to handle a heavier work load in training



Coordinated Training – What are the results?

Primary Results

- Improved Safety at the Mine Site – MSHA expects ZERO accidents
- Improved Productivity - Efficiency in all operations
- Increase the profitability of the Mine Company

Secondary Results

- Enhanced development skills for the operator
- Shorter, but more intense training periods
- Malfunctions and Emergency Training are Coordinated
- Better use of the Instructor's time
- Improved Machine Health – Reduced Maintenance cost related to operator abuse

