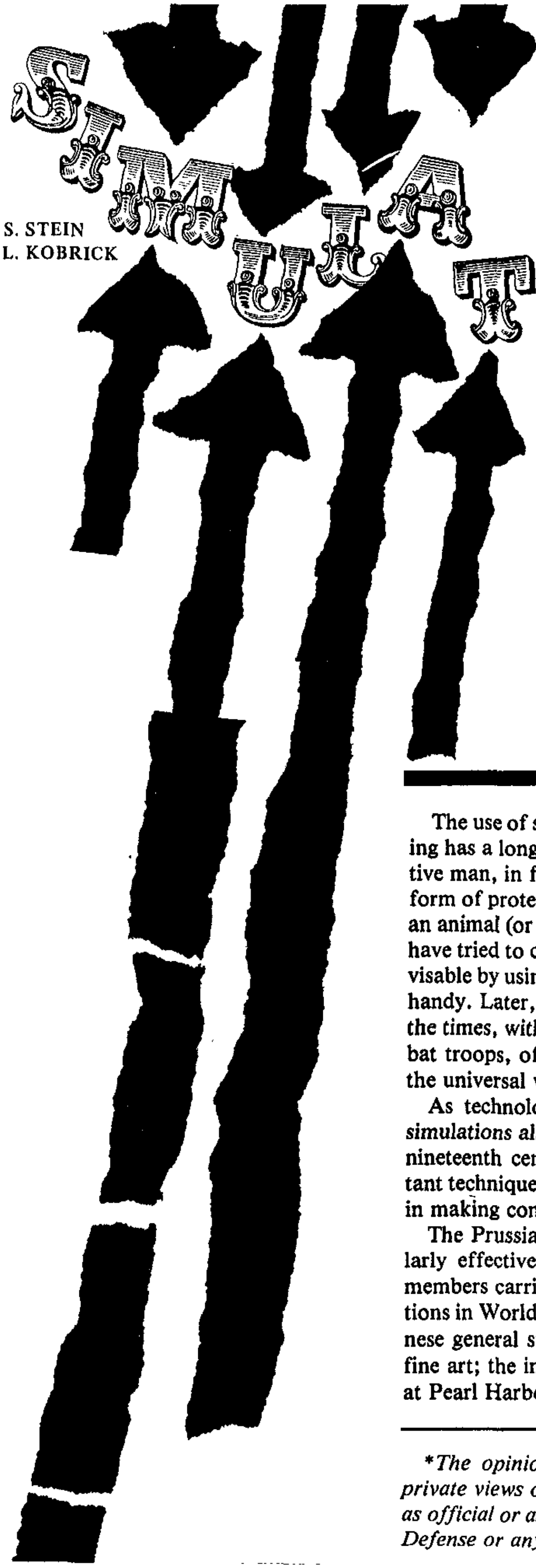

SIMULATIONS a brief history

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The use of simulations in military operations and training has a longer history than many people realize. Primitive man, in fact, probably used simulated weapons as a form of protection: An unarmed caveman, threatened by an animal (or a stronger, more aggressive caveman), may have tried to convince his opponent that attack was inadvisable by using a stick to simulate the axe he did not have handy. Later, after the advent of firearms, the armies of the times, with only enough weapons to equip their combat troops, often trained their new troops using, again, the universal weapon simulator — the stick.

As technology and the magnitude of warfare grew, simulations also grew in size and complexity. During the nineteenth century, wargaming developed as an important technique for use in command and staff training and in making command decisions.*

The Prussian general staff, for example, was particularly effective in using wargaming techniques, and its members carried their skills into German military operations in World War I. And in the ensuing years, the Japanese general staff developed wargame simulation into a fine art; the immense success won by the Japanese navy at Pearl Harbor in December 1941 was due partly to the

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meticulous planning and wargaming the naval staffs had conducted before the attack.

Traditional wargaming such as this can be viewed as a low-technology form of simulation that involves boards, player pieces, and detailed rules. It focuses on planning and decision-making but does not require the kinds of physical coordination that are characteristic of the high-technology systems that came along later.

These high-technology systems have their roots in the advent of aviation in the early part of the twentieth century. During the build-up for World War I, the frequency of fatalities in flight training had made clear the need for better training techniques, and out of this need, primitive flight simulators evolved.

World War I vintage flight simulation was a low-technology affair at best, in which simulators were constructed from the materials at hand — in many cases little more than a stick and a chair. Still, such crude simulations as these must have helped in some way — probably by reducing the death and destruction that was then occurring in primary flight training. Otherwise, Army Air Corps trainers probably would have given up on simulations, and it is fortunate that they did not. Simulation for training has had to keep abreast of aviation technology ever since.

During the post-World War I period this technology resulted in the design of the first truly sophisticated trainer, the Link I. This device, affectionately nicknamed "the box," incorporated pilot information displays and a basic movement platform, which would respond to the pilot's control actions and then provide feedback on the results of those actions. The Link I was the forerunner of a long line of flight simulators. The more recent of these have also been used to conduct research dealing with the relationships between people and machines and also with person-to-person performance in a crew or team operation.

Before and during World War II the German Army used an assessment center concept to evaluate its leaders and officer candidates. The assessment center performed personnel evaluations using a unique blend of traditional psychological assessment tools, such as paper-and-pencil tests, and a series of situational exercises, or mini-simulations.

In similar fashion, the U.S. Army Office of Strategic Services (OSS) in 1942 established an assessment center in Virginia at a location it called Station S. There, a staff of psychologists and psychiatrists was given the job of developing tests that could be used to select OSS agents for overseas duty. The Army hoped that an assessment center model could produce a valid and reliable method for predicting the success of OSS agents, but the criteria for evaluating success were never properly defined. (In a book the OSS assessment center staff wrote later, they admitted that the validity of their predictions was difficult to determine since many of the agents who had passed successfully through the test program at Station S never returned from their assignments overseas.)

Since that time, the U.S. Army has continued to experiment with assessment centers and mini-simulations. The so-called Leader Reaction Course, which is now run at many Army service schools, was modeled after the OSS version. In this course young officers and NCOs are given a problem to solve in a limited time using a given set of resources and people — getting a squad of soldiers across a stream, for example. Performance on such a problem is usually measured on a rating scale administered by one rater, although many assessment center simulations use multiple raters to improve the reliability of the results.

The Army operated an assessment research center at Fort McClellan in the 1960s and also one at Fort Benning from 1972 to 1974. The center at Fort Benning was organized as a pilot research project sponsored by the Infantry School and supported by the Army Research Institute for the Behavorial Sciences (ARI). It was operated primarily by and for infantrymen, and although these infantry personnel knew very little about measuring behavior, they did have much to offer toward the development of simulations. In the Army tradition of making do with whatever was available, these infantry assessors designed simulations for a wide variety of tasks ranging from administration to leadership in field combat and developed role-playing exercises and group decision-making situations. (It is important to note that other allied military forces, particularly the Israeli and British Armies, have become interested in assessment simulations. The British, in fact, now screen all of their enlistees before assigning them to specialized training. They also use their assessment centers to select candidates for the National Military College at Sandhurst.)

Although the Army's work with assessment centers did not produce models for making long-term predictions, it did do much to support the use of simulations for training purposes. Besides flight simulation, which still plays a major role in the training of Army aviators, the Army has created a series of varied simulations. Over the past 15 years, for example, the Combined Arms Training and Development Agency (CATRADA) at Fort Leavenworth, Kansas, developed an entire family of war games. These war games, referred to as battle simulations, run the gamut from squad to brigade level.

Although much of the research done with battle simulations has focused on decision-making for leaders and on inter-staff communication, these simulations also offer a fertile ground for evaluating the effect of various stresses on battalion and brigade commanders and staff officers. The behavior of the participants in such simulations, in fact, mirrors quite well what they would be doing in actual field tactical operations centers.

ENGAGEMENT SIMULATIONS

When it comes to field training itself, historically it has been conducted much like the childhood game of Cops

Soldiers from the 1st Battalion, 28th Infantry, prepare for MILES training in the field.

and Robbers — "Bang-bang, you're dead." In the 1970s, however, the Army began to change its field training programs to include the use of a simulation system that was based more on casualty assessment. This system was designed to teach small units to perform combat operations in a relatively realistic environment without the obvious hazards of actual warfare. A group of these simulations became known by the generic term *engagement simulation* (ES). The first ES, called SCOPES — Squad Combat Operations Exercise (Simulated) — was developed by a joint working group that included combat veterans as well as psychologists.

Such engagement simulation exercises differed from field training exercises (FTXs) in the way casualties were assessed and in the way this assessment influenced troop motivation. Instead of using umpires who made arbitrary judgments concerning simulated life and death conditions, ES employed a complex system of controllers, radio communications, telescopic sights, and identification numbers for the personnel involved in the exercise. The basic concept underlying this low-technology simulation was that if an infantryman could be seen, he could be killed. Thus, every soldier wore an identification number derived from a set of key numbers assigned randomly to the opposing forces. If an enemy soldier could read an identification number through a low-power telescopic sight and then fire his weapon, the soldier wearing that number was considered killed in action. (The controller with the soldier's unit received the message by radio from his counterpart on the opposing force and informed the soldier of his demise.)

Exercises such as these were quite popular with the soldiers; the commanders of units involved in the development of ES reported that during the exercises both disciplinary problems and AWOL rates declined. This may have been because of increased motivation or identification and involvement with the exercise, or it may have been because of the sheer novelty of the ES program.

In either case, ES was destined to grow in use and application until it expanded beyond infantry units to include armor units and combined arms teams. SCOPES eventually was retitled "Realtrain," and artillery and air defense models were also created and tested. In the course of these developments, it became clear that the largest unit a manual control system could handle was a company or a company team and that even this was barely achievable.

LASERS

Technology caught up with ES in the mid-to-late 1970s when the Combat Developments Experimentation Command (CDEC) developed an instrumented range at Fort Hunter Liggett, California. In this system, casualty assessment was based on the use of lasers instead of bullets. All the soldiers and the weapon platforms (tanks, APCs) were equipped with "eye-safe" lasers and associated detectors. If any detector was struck by a laser from the opposing force, a computer determined whether the contact was to be considered a destruction, a hit with disability, or a near miss. This instrumented range kept track of the location of every major weapon system and vehicle that was taking part in the exercise and made it possible to conduct detailed after-action reviews. This system, therefore, had considerable research potential. Position location, or "ground truth" information, could be stored in the computer; in addition, every engagement could be recorded and stored on a time-based storage medium. (CDEC has used this range extensively since that time and still employs it for systems and concept research.)

Laser technology also made it possible to use ES to support exercises for units larger than a company or a company team. TRADOC began the development of laser applications to training systems in the 1970s and expanded the technology to include portable laser training systems for use at home stations. Collectively, these became known as the Multiple Integrated Laser Engagement System (MILES).

The National Training Center (NTC) at Fort Irwin, California, now makes the most sophisticated use of combat simulations in the Army, including MILES. The Center not only uses the latest ES technology, it also features a permanent opposing force that performs military operations based on Warsaw Pact tactics. Each combat battalion in the U.S. Army is sent to the NTC periodically so that its soldiers can experience the reality of desert combat without also experiencing its hazards. The level of realism and stress at the NTC is considerably higher than that of anything else units are ever exposed to, short of actual combat.

The potential uses of simulation in training and research are many and diverse. The main advantage of using simulation techniques are lower costs, greater control, and safer conditions. Cost is a particularly relevant factor, as is the wear and tear on operational systems.

At the same time, safety is an ethical consideration as well as a practical one. Simulation provides an opportunity for creating situations that are critical to training but that contain no actual hazard. ES can create, for example, the sights, sounds and, some have claimed, even the feel of battle without the dangers of real combat.

As for research, simulation can offer the researcher a wide variety of techniques and can give him greater control of the experiment. The level of control the experimenter maintains over the test conditions in simulation gives him many opportunities to measure behavior that he would not otherwise have. Computer simulations also make automated data collection possible.

But all of this raises the issue of simulation fidelity. It is an oversimplification to say that *fidelity* is synonymous with *realism*. Ideally, a high fidelity simulation should give the participants the sense of "being there" to the extent that they feel they are a part of the system being simulated. This is not to say that to be useful every simulation must have perfect fidelity. The level of fidelity in simulation is always a trade-off between cost and expediency; with enough money and time, just about any system known to man can probably be simulated.

Accordingly, the importance of simulation as a research tool must be kept in perspective. It is, after all, only a means to an end, not an end in itself. An effective simulation must place human participants in a realistic situation or an operational environment in which they can perform their actual duties. Their actions in that environment will be a function both of what they bring with them (skill, knowledge, ability, motivation) and of the contingencies the situation itself establishes. But by balancing the fidelity required to get the job done with the operating cost of achieving that fidelity, researchers and trainers can create settings in which participants are motivated and allowed to perform their tasks much as they would in the real world. The relevance and applicability of the results to Army operations will continue to speak for themselves.

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