

# Tutorial

## RoboKent – a case study in man-machine interfaces

*Jan Larson*

### The author

Jan Larson is Marketing Communications Manager, The Kent Co., 2310 Industrial Parkway, Elkhart, Indiana 46516, USA. Tel: +1 219 293 8661; Fax: +1 219 295 8610; E-mail: kentinfo@kentco.com

### Abstract

The idea of robotic floor cleaning landed on the housekeeping industry like an alien from outer space in the early part of the decade. An industry that had seen little progress in the past 100 years suddenly was faced with a method of scrubbing and sweeping floors without a human being trailing a machine. It was frightening for employees unfamiliar with computers and afraid of losing their jobs and it was no small outlay for the housekeeping budget. It has taken less than five years for an industry, managers and staff alike, to realize the benefits and lead the way into the future with service robots.

Seeing is believing when it comes to cleaning with RoboKent

### Reactions and acceptance of robots in housekeeping

Robots aren't here to replace us; they're here to help us. I'd tell anyone considering using robotic equipment that the RoboKent robotic scrubber is a very safe and efficient cleaning machine.

Those are the words of Earl Mins, a 42-year housekeeping staff veteran at Franklin Square Hospital in Baltimore, Maryland. He has been using a RoboKent robotic scrubber for more than two years and his viewpoint is echoed by everyone who has added a RoboKent scrubber or sweeper to their facility's cleaning staff.

With robotic cleaning equipment still so new in the 1990s, there are two different reactions heard. They are based entirely on whether an individual has had experience with robotic equipment or has only heard about it. Mins admits that he, along with others on the housekeeping staff, were wary of the RoboKent scrubber, but his boss decided it was a good investment. "We did everything we could think of to make that robot fail," he said, "but it did everything it was supposed to. And now we wouldn't want to be without it."

Housekeeping staff personnel chosen to be in charge of the RoboKent cleaning robots first experience fear followed by pride and enthusiasm after a short learning curve. It is the same from coast to coast. Joe Sloan, RoboKent technician at Walter Reed, Steve Sharp, RoboKent technician of Western Michigan University, and Leon Demery, RoboKent technician at Stanford, all admit to initially being afraid of the computers and the high-tech aspect. But it took only 15 minutes to get comfortable with operating the robot and learning what it could and could not do. That learning time frame is backed up by users across the board. As Bill Love, director building services at the University of Cincinnati reports, "Once our employees found out that the robot would be an assistant, not a job eliminator, they accepted it immediately." Introduced in 1993, after four years of development and on-site testing in dozens of locations around the USA, robotic cleaning with RoboKent scrubbers and sweepers still has to be seen to be believed. But those who have had the experience are universally enthusiastic.

The RoboKent ScrubberVac Generation 6 Model



### Training time

Joe Sloan was the first at Walter Reed to work with the robots and he trained the rest of the staff. Not that there was much training needed according to Joe:

These machines operate the same way every time, using the right amount of solution every time. There's little real training involved, just showing which buttons to push and which types of floor area the robots will work in.

### What to expect

As for performance, Larry Winston, chief of environmental services at Walter Reed Army Medical Center, Washington, DC, says the RoboKent scrubber delivers one of the driest operations he's ever seen.

It puts down the scrubbing solution, scrubs the floor, and picks up the solution leaving very, very little residue. And what residue it leaves dries almost instantly.

RoboKent owners testify that their robotic scrubbers work better and more consistently than their older traditional scrubbers, leaving no streaks, just very clean floors.

### How RoboKent robotic cleaning equipment evolved

During the mid-1980s, The Kent Company's owner, AB Electrolux of Sweden, became interested in the possibility of roboticizing some of the many products produced by its companies around the world. The company decided to focus on investments in new product design which would carry it into the future and establish it as leader in robotic and technological advancement. Of the products

represented by their more than 600 companies worldwide, it was decided that an automatic floor scrubber made by Kent in Elkhart, Indiana would make a good first experiment in robotics.

In 1986, AB Electrolux developed a research partnership with Transitions Research Corporation of Connecticut, a young company geared toward the development of mobile robotics. Initially, a 32in. Kent automatic scrubber was sent to TRC along with two engineers from Sweden to begin the experiment. There they began to work with TRC's Allen Bancroft, a young engineer on his first job following college.

Determining where the drive motors would go, where the electronics would be mounted, how the machine would turn on a soapy floor and how to make sure the machine could cope with people and obstacles while doing its job were major issues in the beginning according to Bancroft. Several months of work resulted in a model that worked, but, with its 27 gallon tanks and heavy duty construction, it was too big to move around for testing or use.

Early in 1988, experimentation was begun on 20in. machines with 11 gallon tanks. Locating electronics on the side of the machine made the unit too susceptible to damage. Mounting the electronic components on the top of the machine was not feasible because of the chance of solution overflowing into the electronics box during filling. When electronics were mounted on the front of the machine, it was too difficult to protect them from head-on bumps. The rear of the machine was the logical choice for mounting the electronics and it also facilitated servicing.

Deciding the types and the method of mounting the obstacle sensors was the next hurdle. A top-mounted scanner did not work because it was too susceptible to breakage and it did not provide enough information. Sensors mounted on the outside of the brush head so that the machine could scrub right up to the wall did not work because, no matter how they were mounted, they marked the walls. Finally, a non-contact sonar sensor similar to that used in a camera to measure distance was chosen.

### The RoboKent scrubber's introductory appearance

In 1991, the first commercial robotic floor scrubber was put into service at Northwestern

University in Chicago, Illinois. Bancroft, who joined The Kent Company as chief engineer – robotics in 1990, tells of the RoboKent scrubber's first public performance.

There was a crowd watching in awe and the robot performed perfectly. Suddenly, a janitor unaware of what was going on, happened to walk across the opposite end of the hall the robot was cleaning. Seeing the machine moving all by itself while his boss was at the other end of a long corridor, he ran to the machine shouting, "I'll stop it, I'll stop it!" That's a reaction we still get where people haven't seen a robot that teaches itself.

The first RoboKent machines were programmed on-site as they were walked down the hallway where they were to be used. Then, after a few weeks, the robots' owners called us to report that their robots were working just great; would we now come and program them for the other 13, 11 or 25 floors of their building.

That's when we realized we couldn't go into production if we had to travel to every end-user location to program a robot every time they wanted to use it in a different place or the configuration of the corridor changed.

From that came the AutoLearning® process patented by Bancroft and refined by his team of engineers.

### **RoboKent equipment today**

Today, RoboKent scrubbers and sweepers are at work in more than 150 locations throughout the USA (and one in Scotland) cleaning floors without human help. Walking behind a machine, up and down, back and forth, just to guide it while it automatically scrubs or sweeps has always been a waste of human potential. It has become increasingly apparent that robots are a perfect solution for monotonous, routine, tedious jobs.

They are easier to use and they deliver much higher productivity than their traditional counterparts. After filling the scrubber's 25 gallon recycling tank with cleaning solution, all an operator needs to do is turn on the key, squeeze the handle bar and drive the RoboKent scrubber to its job location. Then, with the push of three buttons – one to turn the machine on to "automatic" mode, one to activate the squeegee, and one to activate the brushes and solution flow – the robot takes over and cleans. When it has finished, it signals the operator's beeper and/or beeps where it stands while it waits to be driven to its next job. While the RoboKent machine does the mundane work of cleaning floors, its operator is freed to do detail tasks such as restrooms,

baseboards, edges and corner cleaning, windows and other jobs that often have been let go owing to lack of time.

During its first cleaning pass down the center of a hallway or corridor, the RoboKent "learns" the area it is in. Then it continues back and forth until the whole area is cleaned. According to housekeeping management, one person with a cleaning robot can do the work of nearly two people. And this employee does not call in sick, take coffee or smoke breaks, or get stuck in traffic on the way to work. That means up to a 90 per cent increase in productivity.

Currently proficient at cleaning hallways up to 27ft. in width and of indeterminate length, the RoboKent will also move from hall to hall, hall to aisle, or aisle to aisle automatically unless a "wet floor" sign is placed in an opening. "Wet floor" signs tell the robot's sonar that the cleaning job ends there.

RoboKent scrubber working at Stanford University Medical Center with Leon Demery doing detail work on window ledges



Operable in either robotic (automatic) or manual mode, a RoboKent scrubber vac or sweepervac teaches itself the area to be cleaned with the aid of computers, wheel counters, sonar and infrared sensors. The main computer monitors all data and computes Auto-Learning. Wheel counters register the length of the hallway and a six-point sonar system orients the machine to its surroundings and registers distance to walls on either side. A two-point sonar looks above and in front of the RoboKent machine for overhanging obstacles. Brush head sensors activate with 8 ounces of pressure to assist in obstacle avoidance and, finally, sensors identify ledges and drop-offs to keep the robot safe at all times. In all, a total of 18 sonars are employed to keep the machine on course.

### Obstacle avoidance

A ten-point sonar system watches for obstacles and corrects the robot's course to avoid them with a wrap-around touch-sense bumper for assistance. Stories abound about the robot's amazing ability to stop when it "sees" an obstacle. The tale told by Leon Demery of Stanford University Medical Center is the most dramatic.

Soon after he began using the RoboKent scrubber, an infant got away from his father in the hospital waiting room and crawled into the robot's path. The machine stopped well short of the child as it was programmed to do while Demery, who was several feet away wiping down railings and could not reach the machine, watched. The father's relief was overwhelming, and after recovering his composure, he wanted to hear all about this remarkable machine.

His experience mirrors those of Winston at Walter Reed Army Medical Center who tells of doctors and nurses who talk "medicines" and pay no attention to what is around them. In his words, "the robot stops on a dime and gives you nine cents change!". Whenever an obstacle is encountered, the robot stops and, after 12 seconds, will go around if the obstacle does not move. If the object moves out of the way, the robot continues cleaning in a straight path. And, if someone were to jump right in front of the machine allowing it no reaction time, contact sensors activate with only a few ounces of light contact causing the RoboKent to stop and back up.

Control panel



### Environmentally friendly and safe

RoboKent scrubbers feature a recycling system which can be turned on or off. When selected by the operator, the system sends used solution through a 150 micron sock filter and a 100 micron stainless steel filter in the bottom of the recovery tank. The solution is then pumped through two cotton cartridge filters with a filtration capability of five microns. This solution, filtered through four filters, is then returned to the clean solution tank for re-use on the floor. All filters are re-useable. By using the recycling function, the machine's run time is maximized.

Power is provided by four 200 amp hour six-volt heavy-duty deep cycle batteries that accompany the machine in a slide-in/slide-out polyethylene open-top carton. A single charge lasts for five to five-and-a-half hours. Removal and replacement of the battery container is made especially easy with an optional patented battery cart designed to hold two sets of batteries. When positioned next to the robot, the spent batteries slide out directly onto the cart and then the cart is rolled forward putting the new battery pack in position for sliding in smoothly with no exertion by the operator.

As with all battery-operated equipment, battery weight can cause problems as can the possibility of acid leak should the batteries be tipped incorrectly. "We don't have to worry about those safety issues anymore now that we

have the robots,” says Ronna Anderson, housekeeping manager for J & J Maintenance’s housekeeping contract at the David Grant Medical Facility at Travis Air Force Base in northern California. Winston agrees with her, pointing out that the four batteries weigh approximately 260lb.

#### **No built-in guides or installation necessary**

The ease of using a RoboKent scrubber or sweeper is a top selling feature. No special installation, cords, built-in guides or reference markers are needed for these cleaning robots. In fact, after uncrating the machine, the RoboKent is ready to begin working. They will clean up to 65,000sq.ft per charge and solution change, between 10,000 and 13,000sq.ft per hour. RoboKent machines can actually be used 24 hours a day with three sets of batteries with downtime necessary only for solution tank emptying and refilling and battery changes.

RoboKent coming down a hallway at Western Michigan University



#### **Why housekeeping turns to robotic cleaning**

Reasons for purchasing a piece of robotic cleaning equipment are many. Indiana State University of Terre Haute, Indiana, purchased a RoboKent scrubber specifically because of its recycling feature. According to Barb Lawrence, director of housekeeping, recycling and re-use of resources is a strong part of the university’s mission. Using cleaning equipment that fits with that mission is a natural extension of the university’s desire to become known for its dedication to the environment.

Stanford University of Stanford, California is known as a leader in technology, investigating every new idea as it is brought to its attention. According to Karl Hickethier, director of housekeeping and grounds at Stanford University Medical Center, the hospital now has three HelpMates™ that robotically deliver medications and other supplies, one solar powered robotic lawn mower and three RoboKent scrubbers and sweepers.

But most owners of RoboKent scrubbers and sweepers point directly to the bottom line as the reason for their purchase of robotic equipment. Sales of robotic cleaning equipment depends primarily on the buyers’ perception of value, productivity and return on investment. “Our housekeeping staff has lost 31 FTEs (full time employees) in the past seven years,” says Larry Winston. Between downsizing and increased demands, not to mention skyrocketing costs, we would be greatly understaffed and unable to complete the required tasks were it not for our RoboKent scrubbers. We started with two scrubbers three-and-a-half years ago, and now we have four. For the money, they’re a steal!”

#### **RoboKent’s return on investment**

Payback depends on labor rates, square footage cleaned and the frequency of cleaning time. Building service contractors point to the added service they can give their clients, a fact which helps them win the contract again at renewal time. Umar Abdul-Mutakallim, manager of plant, building and custodial support services at Western Michigan University, Kalamazoo, Michigan, has been able to meet increasing demands on his staff’s service throughout the past four years with the aid of his RoboKent machines which now total five. The machines pay for themselves in as little as two months or at least within two years

according to their owners. They also account for a reduction in staff overtime, an increase in overall work accomplished, and a cleaner facility.

Both pride and a sense of accomplishment are two side benefits of adding robots to a cleaning staff according to Karl Hickethier, who has been Stanford's housekeeping director for 32 years. Ronna Anderson of J & J Maintenance agrees:

Our traditional scrubbers used to take a beating.

Anderson says:

but the staff takes extremely good care of the robots. They're as clean and shiny, inside and out, today as when we purchased them more than two years ago. And we get a lot of compliments on the luster of the floors. That's a morale booster too.

Even those who were not involved with the robots at their sites now want to learn how to operate their RoboKent cleaning robot:

Hickethier reports:

When the technician in charge of our RoboKent sweeper went on vacation, two of the women on the staff had to cover his area with traditional vacuum cleaners. It took a lot longer and now, at their own insistence, they've become qualified to operate the robot. It simply does more work in less time, and, in addition to being a morale booster for the staff, it [the RoboKent] has become an excellent source of positive public relations. Our doctors, nurses and other staff stop to comment that it's about time we moved into the high tech era.

Visitors, students, patients, children – whoever comes in contact with a cleaning robot – want to know more about them. They are curious and they are impressed. That, in turn, focuses more positive attention on employees in a department that has long been considered lower in status than those of their fellow employees.

The care given to any piece of equipment determines its lifetime. The pride RoboKent

technicians take in their machines translates to superior care which means a longer lifetime than that of a traditional scrubber. It also means less downtime and more productivity, a fact which Jerry Snider of J & J Maintenance based in Austin, Texas, says helped bring the payback time for their RoboKent scrubbers to less than a year.

So dependable are these machines that they feature a three-year, bumper-to-bumper warranty with an additional two-year warranty available. And, whenever new software technology is developed, every existing RoboKent is designed to incorporate the upgrade. Upgrades are done at no charge during a machine's warranty period.

### **RoboKent cleaning – the future**

A Wide-Area™ navigation system will be introduced in the first half of 1998 enabling the RoboKent machines to clean areas up to 300ft. in width. Optional add-ons now available include an alarm and a strobelight. At some point it may even be possible to incorporate a miniature self-contained video camera capable of signal transmission to a central security/video center to assist the security team with monitoring. Future plans call for development of a robotic floor burnisher and household or office size robotic vacuums.

Using the past to predict the future, it can be expected that the use of robots for cleaning tasks will continue to grow. Most facilities and building service contractors who initially purchased one or two robots have added from one to four additional robots to their housekeeping staff. It is a growing market fueled by the testimonials of those who have had to do it the old fashioned way until they met their first RoboKent.

HelpMate™ is a registered trademark of Transitions Research Corporation.