BUSTECH

THE MAINTENANCE NEWSLETTER FOR THE BUS INDUSTRY

SPRING 1999

Going for the cold

SUMMER. TIME FOR VACATION AND (E)VACUATION

Summer is nigh. Which means increased air conditioning system maintenance, including changing filter dryers, replacing expansion valves and overhauling compressors.

Any time any of these things occur, evacuating the air conditioning system of moisture, air and other contaminants becomes mandatory.

In fact, today's high-performance, high-efficiency refrigeration systems become small chemical plants if they are allowed to operate with the presence of moisture and air.

There's even a formula for what happens: High-efficiency refrigeration system + air + moisture = Increased maintenance costs and warranty claims.

To avoid having this formula apply to your buses and coaches, proper evacuation is essential. In fact, it is critical to A/C system performance.

Evacuation is the process of removing moisture, air and any kind of dirt and residue from a refrigeration system. The gases found in air, such as nitrogen and oxygen, are what must be removed from the A/C system. This is called degassing.

Moisture is the other major substance that must be gotten rid of. Moisture, in the form of water vapor, is always present in the air. The water vapor must boil off to be removed from the system. This

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The future

WHY YOU MUST INVEST IN YOUR MECHANICS

By Halsey King
Vice President
BusTech Advisory Services

The universal concern of today's fleet maintenance manager deals with staff skills. Indeed, everyone wants to know how we will locate, train and retain qualified technicians to service today's complex buses.

More importantly, where will those technicians find the information they need to diagnose, adjust and repair bus systems under the repair mandates of the Clean Air Act?

For some time, organizations such as the Automotive Service Council, U.S. military and the Society of Automotive Engineers have been addressing problems of technician competence in the service bay. These problems arise from the growing complexity of electronic systems and the diminishing pool of trained service technicians. And yes, a number of people may be shying away from or leaving the trade because of the poor image "mechanics" have had.

Deep inside, I think they are leaving for other reasons.

Bus maintenance technicians, like everyone else, need to feel they

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Training technicians

NEW YORK CITY TRANSIT RETOOLS MAINTENANCE EDUCATION

By Lia Dibello and
E. Sterling Chamberlain
City University of New York

For many years, management at New York City Transit wanted to implement a centralized, cycle-based maintenance system. That is, a system that predicts failure of equipment ahead of time and allows maintenance personnel to preplan replacement of parts.

Manual systems proved unwieldy, given the size of the fleet (more than 4,000 buses), and early information technologies did not provide the expected benefits. New York City Transit was not unusual in its disappointment. In fact, studies have shown that more than half of all transit information technology implementations fail and upwards of 90 percent do not reach full potential. Many have felt that the new technologies were simply badly deployed.

Like other decision-support systems, cycle-based maintenance systems work best when:

- 80 percent or more of the workforce in a given business understands its basic purpose and the way it uses the information that is input daily.
- The "end users" are those who are "close" to the work being

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done with equally knowledgeable managers supporting them. Numerous studies have shown that intimate knowledge of how work is actually done is required for these systems to operate at their full potential.

ACCURATE INFORMATION IS CRITICAL

The information needed to make maintenance systems work has to be extremely accurate and at the right level of detail to support the system's analysis of repair data for patterned "life cycles." Most agree that the ideal situation involves input at the front line (technician, mechanic or operator) to be accurate and timely enough to be useful. Most also agree that the majority of the workforce needs to know the purpose of the information to enter the correct level of detail.

However, this strategy is usually quite difficult in practice. The usual reasons were applicable at New York City Transit:

- Historically, efforts by the transit agency to educate technicians and mechanics to use computers had not been successful. In general, it was widely acknowledged these individuals were not, by and large, classroom learners. At New York City Transit, many of the workers also did not speak English as a first language (about 80 percent) and had virtually no keyboard training.
- System sabotage. Front-line workers are usually threatened by information systems on the shop floor, often seeing them as "time and motion" studies in PC form. Such attitudes and the relative vulnerability of computer systems led to widespread system sabotage or damage to expensive computer equipment.

In such cases, there are also a always alternatives. But these have problems of their own. For example, the use of handwritten records with clerks or supervisors entering the data has resulted in marked data degradation even when the data were entered promptly. Part of this was due to the clerk's lack of knowledge about the equipment and part was due to front line workers' attitudes. In our research we have found that technicians, mechanics and operators were less likely to hand-write accurate data when they did not understand what it was going to be used for and if they were aware clerks would be interpreting the information for data entry.

NYC TRANSIT ADOPTS NEW APPROACH

New York City Transit was aware that we, at City University of New York, were using "games" to successfully train workers on computer systems. Our success with training technicians and mechanics on a complex computer system using manipulative simulations was seen as a way of making an important large scale, front line computer system a reality at New York City Transit Bus.

Specifically, senior management saw our project as a success in getting technician and mechanic acceptance and mitigating against system sabotage. At the point of our first conversations, they did not recognize the reasons why the method worked. Technicians and mechanics accepted the system because they had learned its business purpose through a simulation exercise in which they could only "win" by using it as a tool to solve the problem of running a transit property within budget, while at the same time meeting service requirements. The managers who eventually hired us also did not agree that user knowledge of the system might be critical to the successful use of the system from a management perspective.

Rather than attempt to convince the management that these factors were important, we proposed to do a training pilot at one location. Ostensibly, this would increase user acceptance and prevent

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Subscription Rates
U.S. and Mexico: $24.00
(U.S.) per year
Canada: $34.00
(Canadian) per year

BusTech is a quarterly newsletter produced by *Bus Ride* magazine and designed to inform readers regarding bus and motorcoach maintenance-related issues.

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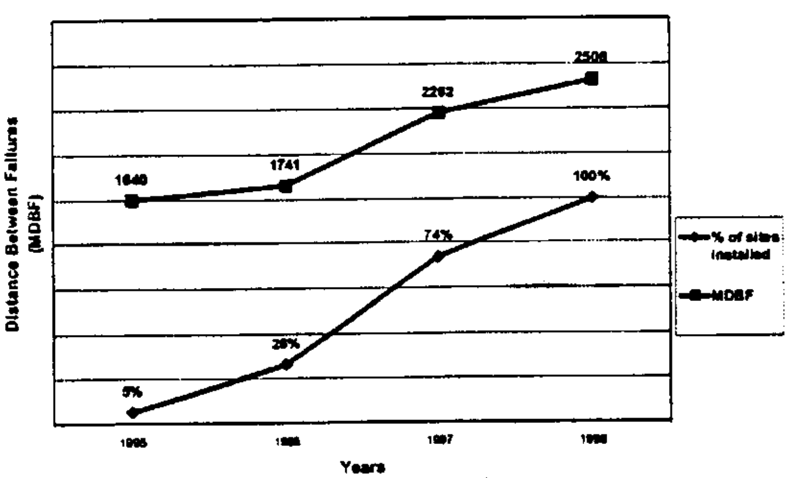
system sabotage of N.Y. Transit's new cycle-based scheduled maintenance system, known as MIDAS, or Maintenance Information & Diagnostics Analysis System, wanted hoping to implement agency wide. The project as designed and eventually rolled out to 19 locations actually addressed the business purpose of the information system. It was a simulation exercise that allowed the technicians and mechanics to bring their experience and knowledge of buses to bear on the business changes needed for cycle-based scheduled maintenance to be successful.

LOOKING AT THE WORKPLACE CULTURE

We see thinking and skills as developing in the service and support of activities at work. In other words, the workplace shapes how workers think about their jobs and the skills they develop to be successful. This is the principle difference between "school learning" and ongoing learning at work. As one participates in a particular industry or occupation, particular strategies and ways of understanding the business at hand are selected and reinforced as they prove over time to have direct bearing on accomplishing important goals. The development and honing of these skills is largely unconscious, although it is something employees pay attention to. That is, workers typically understand they are learning the right things when they are more fully able to participate in meaningful problem solving and are recognized for their value by their co-workers. This set of skills and ways of understanding work comprises the "culture" of any workplace.

When looking at workplace "culture" as really being about skills and accomplishing goals, it becomes clear why the culture of a workplace becomes the main impediment when a widespread change in business practice is being introduced. As discussed above, market changes introduce new goals, which make a particular culture of practice irrelevant, at least in part.

Performance Increase with Computerized Maintenance Management



It is not surprising, therefore, that legacy skills or business paradigms are often seen as "resistance" to the process of change as business goals are re-aligned to adjust to market changes. In fact, when a change is being introduced, change agents (i.e., new management, consultants or a process improvement team) will often disregard the usefulness that previous strategies may add in the process of change. They are often unaware of the important role that prior knowledge can play in the "new" vision. Their strategy is often to replace all legacy practices and the skills associated with them. Many times they see this involving "selling" the change or eliminating key resisters. This usually does not increase the chances of a productive transition. The process of integrating useful aspects of legacy skills with practices that support new and changing business goals is required for any positive change.

By and large, organizations do not understand the process of change and the problem of learning. They also do not understand how the mid-career adult has learned to "learn on the job". They often assume that classroom styles of training will work as effectively as they once did when the employees were trained "school learners." In fact, much of the literature on adult learners written for training and human resources professionals emphasizes the learning problems that adults have. In contrast, our work has shown that adults do not learn less well, but according to different principles, and usually in the context of a problem to be solved.

DESCRIPTION OF WORKPLACE

For New York City Transit's MIDAS system, we built a three-phase workshop. Phase One is designed to "engage the default." Rather than anticipate the entry point of learners, we designed a workshop in which learners may construct their own entry. Rather than a lecture, we give them a problem to solve with goals that are compatible with the technology – in this case MIDAS – they are trying to learn. We also give them a number of tools for solving the problem.

For the MIDAS workshop, we asked teams of eight workers to "run a depot" of 40 plastic buses with relatively complex interior components. Their goal was to maintain 32 buses in service at all times (limiting the number out of service to eight) and order all the materials (within a budget) needed for doing so and evaluate daily operator reports (each "day" being 20 minutes) that might indicate potential problems (e.g., noisy engine). The activity was "rigged" so the only way to meet these goals was to predict what was due to break next. The breakdown patterns of all components followed time/mileage cycle rules and were pre-calculated using a computer. The learners were given adequate tools to predict and calculate this breakdown, including printouts of the repair history for every bus. They also were given other tools, including those similar to the ones used to do "reactive" maintenance.

Close examination of how learners use the tools provided pretty much approximates their work history. People tend to construct a solution to even a novel problem that fits with their experience, even when explicitly instructed to avoid doing so. In fact, the participants are rarely aware they are replicating their normal methods.

Rather than interfere with this tendency, we allow the participants

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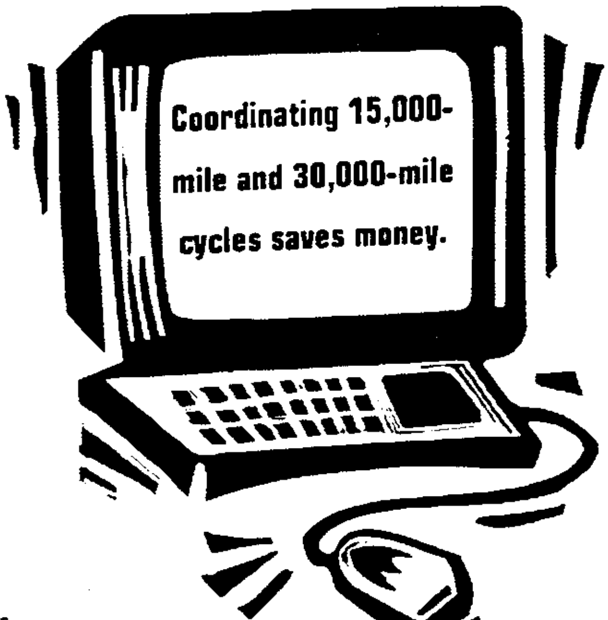
to "wing it," while carefully documenting their cash flow, labor flow, inventory acquisitions and the number and type of on-the-road failures that result from failing to predict problems. Meanwhile, heavy fines are levied for expensive "reactive" problem solving strategies, such as "cannibalizing" an entire bus for a few cheap parts that will get other buses back on the road. Later we show the participants the consequences of their decision-making patterns and the underlying logic they are using. By the end of the first half of the first day, the "depot" is in crisis and the participants are realizing their budget is being expended to react to mounting problems. The activities are stopped, and the team is sent to lunch.

In Phase Two of the workshop, the learners reflect on what they did, as recorded by the trainers. They discuss among themselves what they were thinking as they made various decisions and begin to reflect on their own practices that lead to bad outcomes and practices that are preventive. It is only at this point that the participants are truly open to new ideas about how to solve the problems of maintenance. They also begin to understand in detail the ways they have actually misunderstood preventive maintenance.



In Phase Three, the participants are assisted in building a manual scheduled maintenance system. They spend an entire day setting up the predictive data structures, identifying true cycles from histories (which were available from the first but which now take on new meaning) and – most importantly – coordinating cycles so their "system" is bringing in a bus only once to satisfy several cycles at once. For example, in the MIDAS workshop, the participants quickly realize that a 15,000-mile cycle and a 30,000-mile cycle can be coordinated so that at least half the time the 15,000-mile cycle co-occurs with a 30,000-mile component cycle. Finally, the participants run their miniature depot again using their "system" and see the difference in profits and ease of workflow. Usually only after five "days" the team can afford to buy an additional bus to add to the fleet or elect to give themselves raises.

The last activity of the workshop involves getting on the computer system. After operating as MIDAS, participants navigate through the actual system more easily, know what to look for and ask informed questions. Even computer illiterate workers show little hesitation when exploring the system.

THE POWER OF THE WORKSHOP

We believe the workshop's power lies in the first two phases, when the participants actively encounter the basis for their resistance – their existing expertise and automatic ways of doing things – and re-tailor it to fit new demands and priorities. We find the process of doing this is critical because each individual has a different prior perspective that must be reckoned with. We find it best to facilitate this process of "re-tooling" one's way of thinking rather than trying to overlay the new knowledge on top of the old with lecturing. It seems learning always involves building upon, or reorganizing the way one already understands something. Therefore, it is critical to engage prior knowledge, if only to eventually make sure it is changed or reorganized.

THE PROBLEM WITH SIMPLYFING

Why is it necessary to let the learners do this on their own instead of asking trainers to instruct differently? Based on research we realized that learners with diverse work history backgrounds "enter" into understanding by multiple means. For example, whenever a teacher "simplifies" material for his or her students, he or she is really anticipating the "entry point" of the learners. However, this method often fails with experienced workers because the entry point is not always predictable or universal (for example, "simplified" is often not helpful for those experienced in thinking through vast amounts of detail). The learners themselves – when allowed – actually do better at "breaking it down" in a way that is useful to them.

The proof of this method is in the pudding. When workers who are knowledgeable about buses put in accurate information the results are improved maintenance and increased MDBF. The chart on the previous page shows an almost 1-to-1 correspondence between implementing MIDAS and an increase in MDBF. Further proof is in the users' feelings about the system. In the three years since implementation began, there as been no reduction in mechanic's use of the system, no degradation of the data's quality and no sabotage of computer equipment on the shop floor.

The National Transit Institute is considering the development of a similar workshop to be made available to the bus industry. Please let the Institute know your interest, as visible support helps justify such projects. Contact Eric Bruun at the National Transit Institute: 732-932-1700 ext.18 or e-mail him at: ebruun@rci.rutgers.edu.

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