6 LOGISTICS 5 OF 4 A 3 SUCCESSFUL BICYCLE 2 TOUR 1

BY MERRILL CALLAWAY

When I resigned my position as senior logistic engineer at an aerospace firm to realize my dream of taking a bicycle tour around the world, I took away three principles in logistics engineering that helped me plan a four-year, 28,000-mile tour in 28 countries. I hope applying these principles will help you plan your own tour.

One definition of logistics is the detailed organization and implementation of a complex operation. Logistics engineering as I experienced it was narrowly focused on military aircraft flight-control computers — sometimes called black boxes. A warplane contains several of these boxes, each with a motherboard, computer cards in slots, and so forth, much like the familiar desktop computer except avionics boxes are much more rugged. Each box has thousands of components mounted on dozens of cards. To handle this complexity, my company implemented three formal principles in logistics engineering: reliability, maintainability, and provisioning.

Reliability is measured in Mean Time Between Failures (MTBF). The higher the number of in-use hours, the more reliable the single component or assembly. Failure manifests in three levels. Non-mission critical is when something, usually part of a redundant system, fails and needs replacement, but the system keeps going. A mission critical failure is serious enough to warrant a return to base and cancellation of the mission. A catastrophic failure causes a crash (we did not work on the Space Shuttle, but the O ring failure in 1986 is a famous example of a catastrophic failure.)

Maintainability comprises a set of procedures to be followed at three increasingly complex maintenance levels — on the aircraft, in the hangar, and back at the manufacturer. One way to measure maintainability is Mean Time Between Unscheduled Maintenance Actions (MTBUMA). A low number indicates a high-maintenance system.

Provisioning is a list of which and how many spare parts or assemblies should be stocked at each maintenance level, as a function of MTBF and MTBUMA. This ensures spare parts are available when needed, but not overstocked.

One day, I realized that except for the difference in complexity, much of what I was doing at work would apply to my bike-tour planning. I could save guesswork if I thought of my bicycle, camping equipment, even myself as systems to be analyzed with respect to reliability, maintainability, and provisioning.

My job required analyzing statistical data, which I could not do with my touring systems because there is no data available regarding reliability of bikes or camping gear. I could, however, obtain reasonable estimates — instead of hard data — from my own experiences and from information provided by other cyclists, especially those who had completed a long tour.

My job's deliverable was a document called a Logistics Support Analysis Record (LSAR). It lists each and every component, assembly, and sub-assembly comprising the avionic box. The LSAR also documents procedures on how to test each component and assembly at each maintenance level and how to remove and replace it at each level.

So I created a simplified LSAR for my bike tour, resulting in accurate checklists of which components to use and which tools, spare parts, and even food and camping gear I should take. You can do this too, and customize your own checklists. Begin by thinking in terms of your systems: you have a bicycle, and if you are camping, a "house" containing a bedroom, kitchen, bathroom, and closet. Your bicycle system has sub-assemblies: a drivetrain subdivided into the crank, chain, cassette, front and rear derailers, shifters, cables, and so on. The bedroom contains a sleeping pad, sleeping bag, liner, pillowcase, etc. You get the idea.

Now go over each item in each system's list and ask questions (you can add more of your own) in the three main areas:

How reliable is it? Will my tour last longer than its natural life (reliability)?

Can I fix it if it breaks? What tools would I use (maintainability)?

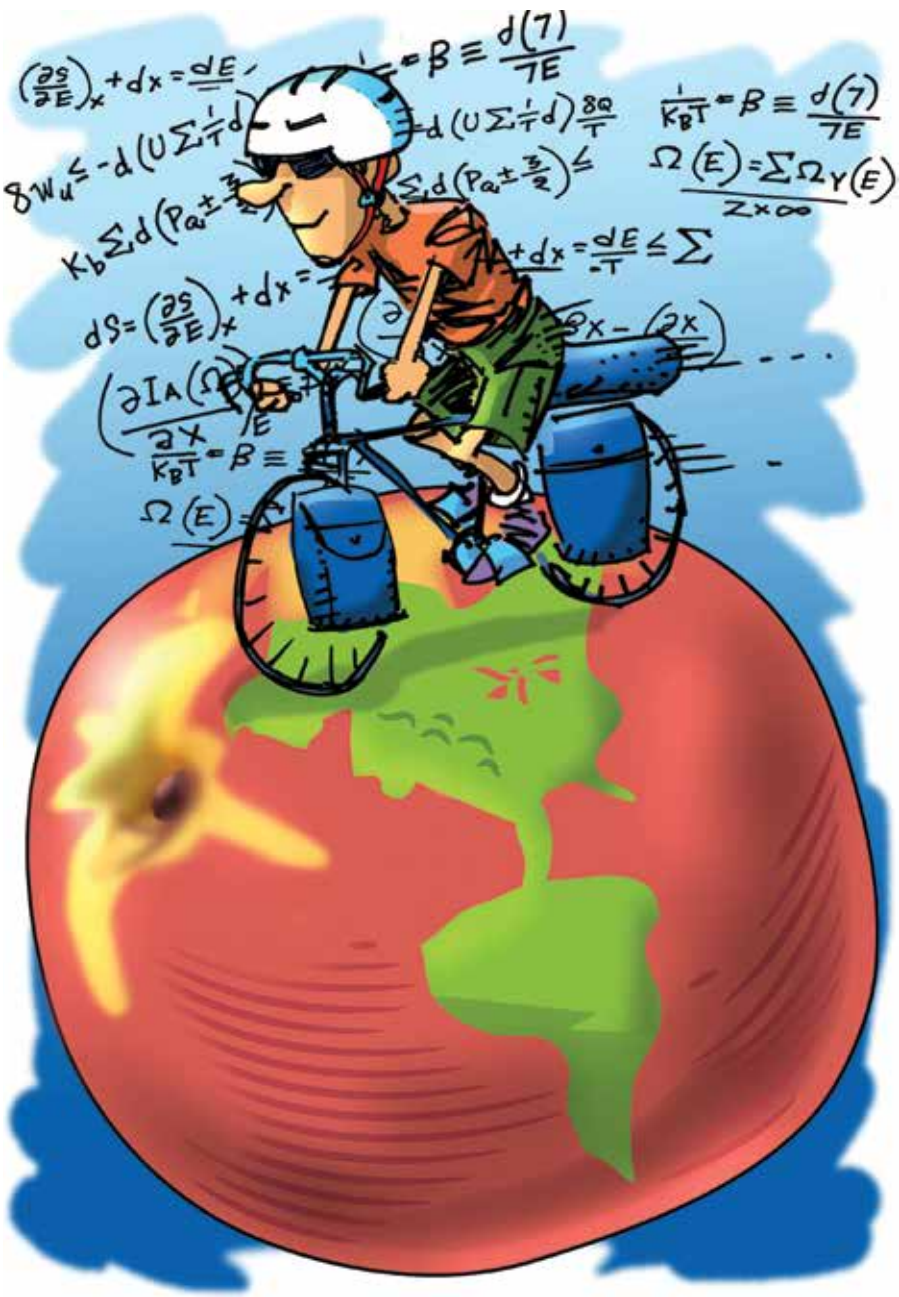
Should I or can I bring a spare (provisioning)?

Another important question meant to help reduce your load is: Can I do without it? The first time you go through this exercise, you will have far too much stuff so repeat it to gain more efficiency. Some ultralight tourers take this to the extreme. But too much stuff has, literally, a weight of its own. Only you can decide the contents of your ideal kit, but the limit seems to be how much you are willing to suffer.

In short, how can I keep myself, as well as my systems, alive and working well while on tour? Don't forget you yourself are a system for purposes of this exercise. Your subassemblies would then be your feet, legs, hands, arms, torso, and head — all of which require clothing and protection from the elements (provisioning), and perhaps vitamins and medicines, and definitely a first-aid kit (maintainability). Even your selection of where to tour might be a function of your fitness (your body's reliability).

Because only anecdotal data about reliability and maintainability exists, perhaps some of my experiences relating to logistics will help you plan your tour or choose equipment. By all means, collect stories about unexpected problems from other cyclists. Sharing war stories in campsites with other cyclotourists made for some of my favorite evenings.

A touring bicycle must endure more abuse and neglect than any other type of bike. The longer your tour is, the more you will realize this. Reliability is of paramount importance, and wheels are the most important moving parts. Be extremely careful when choosing wheels so that you don't get caught up in the current craze to go light at all costs. Wheel failure may cause serious injury so upgrading to a set of very robust touring wheels will be money well spent. I build mine using high-quality, low-flange hubs, the most robust box-section rims (these won't be the lightest!), plain 14-gauge spokes (at least 36, preferably 4-cross, in no case less than 3-cross), and 28-millimeter tires or wider. Sturdy wheels are especially important if you use disc brakes as discs concentrate all the stopping forces along the spokes into the spoke holes in the rim. The diffuse forces applied directly on the rim by cantilever brakes are far less stressful on the rim. For touring I use cantilevers. You almost never see 4-cross lacings anymore, but I prefer 4-cross because the spokes are more tangential to the hub flange, creating more give so that the wheel absorbs stresses rather than transferring them to the rim. On a touring bike, stiff is not always better, nor is it more comfortable.



LUKE MCDONNELL

In aerospace we had a process called "burn in" where we would run the box under harsh conditions in a high-altitude, sub-zero chamber while vibrating it intensely. My bike touring equivalent: Never start a tour with new or untested equipment. Do a shakedown trip first where you can circle back home to make changes. This goes for camping gear and clothing too. Don't forget that robust "unbreakable" things are not exempt. Such things as your seat and handlebars are especially troublesome if they are uncomfortable, and you won't know that until you have lived with them for a while.

The frame is the most important element of your bicycle. The geometry of a touring frame is as important as its material and workmanship. Because you cannot upgrade a frame, it is important

to buy a purpose-built touring model in the first place, if it is at all possible (see the Touring Bike Buyer's Guide on page 10). Proper geometry means the loaded bicycle can carry substantial weight on front and rear racks without any shimmy, especially when descending at high speed. Almost all purpose-built loaded touring frames are made from steel. Steel is the most reliable as well as the most maintainable (repairable) of materials. Contrary to popular marketing hype, a high-quality, butted-steel frame also gives the sweetest ride. I own bicycles made with many different materials — steel, titanium, aluminum, carbon — but my touring frames are steel.

Maintainability is all about fixing or replacing things that fail. The likelihood of needing maintenance or replacement is, of course, dependent on how long your tour is and perhaps how dirty the environment will be. If your tour is just for a few months on pavement, and if your bike is set up properly with reliable components before you leave, rarely will you need to replace anything because of failure, except possibly a tire or tube. You should expect to perform routine maintenance such as cleaning the chain or the entire bike, lubing, adjusting cables for stretch, fixing flats, etc. In four years and 28,000 miles of touring, I experienced punctures and wore out dozens of tires. An unexpected failure of a shifter necessitated a replacement. I also replaced brake pads, a derailer cable, and several chains as they became worn and stretched. That's it!

IF YOU EXPECT TOTAL SECURITY, YOU WILL BE DISAPPOINTED. ADVENTURE AND SECURITY ARE MUTUALLY EXCLUSIVE.

Near the beginning of my world tour, I spent six months almost entirely off pavement on a mountain bike in Mexico exploring Barranca del Cobre (Copper Canyon) in the Sierra Madre and over 1,000 miles in Baja California. If you decide to do expedition touring, you must become self-sufficient, at least as far as keeping your bicycle going. In central Baja, in order to ride for a week down a desolate but stunning stretch of Pacific coast, I had to ride 100 miles out of my way over to the Sea of Cortez side to find food. While braking hard on one ultra-steep downhill, I put so much force on my rims that the tire kept rolling while the rim stayed put despite the fact that I had glued the beads to the rims to prevent this from happening. The tube valve got cut, ruining the tube. Being left with no spare, I continued on without. A couple of items I brought saved me. They were a square of cordura nylon and a tube of liquid rubber, the kind used to fix the sole of a hiking boot. Sharp rocks would cut the tires, especially their sidewalls, until a sort of tube aneurysm would start bulging out of the cut. When camping

for the night, I'd take the tire off, cut a patch from cordura, smear both surfaces and the area around the cut with boot-patch rubber, and press the patch firmly on the inside of the tire over the cut. When cured this reinforced rubber goo would create its own tire casing and prevent the tube from bulging out of the cut. By the time I reached Yuma, Arizona, and visited a bike shop to buy new tires and tubes, my tires looked so beat up and decrepit that the guys at the shop asked if they could display them on their wall like trophies! If you anticipate needing spares that are too heavy or bulky to carry, and you know where you will be and approximately when you will be there, you can have packages sent ahead (this is part of provisioning).

By now, you should have some pretty good checklists enumerating all your gear, with associated tools and spare parts to provision with. I am fascinated when I observe the spare parts people carry. One time, on a tour near Columbia Icefields, Canada, I spied a strange sight on Sunwapta Pass: a brand new Toyota Land Cruiser was towing an identical brand new Toyota Land Cruiser. I thought, "Now here is a guy who is really scared about breaking down in the Great White North. Just in case, he brought along a spare car!" Ever see a bike tourist with a spare wheel strapped on top of his load? This is someone who is afraid the wheel he is riding on will fail. I am confident in the sturdy wheels I build and have their reliability history to back me up. Again, the idea is to bring just what you need (and trust) and nothing more; easier said than done. If you expect total security, you will be disappointed. Adventure and security are mutually exclusive. The challenge is part of the fun — solving problems you did not plan for and using what is at hand to get by.

It should be obvious that you should always carry some emergency food and water. You might enjoy hearing how I learned this lesson the hard way many years ago. I pioneered a century loop back in the 1970s out of Santa Fe, New Mexico. There were two small stores along the way at Stanley and Golden where I usually bought food, so I packed very light, taking only water and one nectarine. As (bad) luck would have it, both stores were closed that day, so I didn't get enough to eat. The route is desolate and hilly, and just as I started seriously bonking with 30 hilly miles to go, I said out loud with a weary sigh, "Oh, Lord! If only I had brought one more nectarine!" Just then, a rusty pickup came up from behind, slowing to match my speed as it came alongside, and a gorgeous blond girl was leaning out the passenger window. She cried, "Hey! Do you want a nectarine?" She held out a gigantic juicy nectarine and handed it to me just before the truck accelerated away. To this day, I wonder if she was an angel; she certainly looked like one! AC

Merrill Callaway designed his custom touring bicycle and pedaled it 28,000 miles, visiting 28 countries in four years. He has been a bike-shop mechanic, a logistics engineer, and a web application software engineer. He is the author of two books on programming. He lives in Albuquerque, New Mexico.