SMART POP

FROM

Boarding the Enterprise:
Transporters, Tribbles and the Vulcan Death Grip
in Gene Roddenberry's *Star Trek*

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Exaggerate with Extreme Prejudice

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WHO IS THE MOST CRITICALLY IMPORTANT member of the *Star Trek* crew?

While the answer should be obvious, you'd be amazed at just how many people come up with the wrong answer, many naming Kirk or Spock without giving the question any real thought. To really answer this question, it needs to be personalized a bit–you have to put your own skin on the line.

Let me rephrase.

Imagine you are a member of a Federation negotiating team being sent to Rigel XII to hammer out the details of a dilithium trade pact with the local miners. You are not the head of the team, but a technical advisor, knowledgeable in dilithium crystal defects and able to point the way to the mines with the very best crystals. The mission is high priority, so the Enterprise has been shanghaied by the Powers-That-Be to transport you and the rest of the team to Rigel XII, the ship's high warp capabilities making it the only vessel in the quadrant capable of getting you there in time. The question should now be put to you–if only a *single* member of the core Enterprise team could accompany you on what should be a boring transport mission, just who would you most want to see along for the ride?

Now it's personal.

Would you pick Captain Kirk? It should take less than a moment's reflection to realize that he would be the *last* member of the crew you'd want along. All you want to do is get to Rigel XII, but if Captain Kirk is seated on the bridge you know the prospect of arriving on time is slim to none. Without a doubt, a distress call will be received, an anomalous burst of radiation will be detected, an unknown entity will be beamed into the ship or the entire crew (including you) will be transformed into cubes when the ship is taken over by a group of aliens from another galaxy looking for a ride home.

There is no question that Captain Kirk exhibits a wide range of talents, but none more powerful than his ability to attract trouble. With a bit of luck, Kirk won't be with you on the Rigel XII run but instead away on some secret mission in search of cloaking devices on the wrong side of the Romulan Neutral Zone.

So how about Spock?

This might seem to be the *logical* choice. Spock understands what it is to complete a mission, to focus all of his immense mental powers on the problem at hand and get the job done. Unfortunately there is one major problem when it comes to trusting Spock with your well-being. Just beneath Spock's cool, logical exterior boils a maelstrom of writhing emotions—and anything can release them.

Spock's emotions can be unleashed after exposure to spores, traveling back in time, viewing certain alien races or even as a result of his own biochemistry—God help you if he's sitting in the Captain's chair when Pon farr strikes and he goes into heat. No, Spock's potential emotional outbursts simply make him too unstable.

Dr. Leonard McCoy? Be serious. If you need your brain reintegrated with your nervous system, a plague serum synthesized from moss and mud or a rather grumpy individual to stand around the bridge and needle the crew with sarcastic barbs, then McCoy is your man. But to sit in the Captain's chair? To expect him to be able to make a decision as to whether to fire a photon torpedo or to shift power to the fore or aft shielding is just asking for disaster. As McCoy would no doubt tell you—for God's sake, he's a doctor, not a cab driver.

So whom do we have left?

The individual you should have picked at the get-go, the only member of Enterprise's senior staff that I would ever trust, is none other than Chief Engineer Montgomery Scott. Think about it. This is the man who is responsible for the warp drives, the deflector shields, the transporters, the computers and the replicators; he practically sleeps in the Jeffries tube. If the waste system aboard the Enterprise becomes quantum entangled with the storage vats of a Vulcan sludge transport carrying le-matya scat, and every toilet aboard the Enterprise starts spewing the noxious cat-waste, whom are you going to call? Montgomery Scott will be to your quarters with a hyperdimensional wrench in hand before Kirk can finish signing logs for Yeoman Rand, before Spock can stop crying as he dredges up his childhood memory of the tragic death of his le-matya and before McCoy can tell you that he's "a doctor, not a plumber."

Scotty is the go-to guy.

And this is because he's an engineer. Engineers have two very remarkable abilities–they can make things work, and they know how to lie to those in command. The first attribute is obviously a good thing. If I'm going to be transported up from some mudball of a planet during an ion storm, I want Scotty at the controls of the transporter. He can play the graphic equalizer control board of that machine like Bach banging at a piano keyboard; he has the *feel* for machinery.

But what about his ability to lie?

Perhaps lie is too strong a word. How about exaggerate with extreme prejudice?

I've been an engineer for better than twenty years. While it's true that I've never actually been on a starship, attempted to alter the matter/antimatter mix of a warp drive while under power or tweaked shield harmonics so that an away crew can be beamed up from Tycho IV while the Enterprise is still able to deflect incoming photon torpedoes, I've performed the one task that *every* engineer faces, whether mass producing wing nuts or calibrating tricorders.

Engineers make projections.

From personal experience, this is how it goes. A section head makes a visit to the lab, where I stand before a big, hulking sprawl of stainless steel and vacuum pumps. My job is to use that machine to grow synthetic crystals of various semiconductor materials, one atomic layer at a time, onto a substrate–a process called epitaxial growth. In the vernacular of my job, the final products that come out of my machine are called "wafers." This is the first step in a several hundred step process that will eventually spit out a high-frequency integrated circuit destined to fly in a satellite due to be launched in thirty-six months. The name of the division, of the company and of the satellite will remain unnamed in order to protect the innocent (me). The viability of this $300 million satellite depends solely on the performance of this critical high frequency chip, which in turn depends on my ability to place a whole spectrum of atoms in just the correct atomic locations as I grow the epitaxial layer.

Management has a strategy—they always do.

The more wafers I can produce, the more integrated circuits will be generated at the end of the production line, which in turn will increase the odds of fabricating one that meets the obscenely impossible operating specifications that some office-bound design geek in a distant division has specified. Management's strategy centers around the premise that the more wafers I can produce, the greater the odds of finding the golden integrated circuit.

Being a good engineer, having worked on numerous programs in the past and not having gotten fired for missing production quotas, I know what has to be done. I have honed the ability to exaggerate with extreme prejudice to razor perfection.

The section head asks me how many wafers my machine can produce a week. This is an extremely complex question, requiring me to consider hundreds of machine and physics parameters, yield statistics, raw material inventories, technician hours and program budgets. But I don't actually have to run those numbers, because I know *my* machine; I have an empathic connection with it in the same way that Scotty knows *his* warp engines.

If I stroke my machine and whisper affectionately to it, making sure that no one else puts their clumsy hands on it, I can squeeze out forty wafers a week.

Of course I don't tell this to the section head.

I spend several minutes telling my section head the gruesome details of how my machine can implode, melt, fry its electronics, blow its vacuum, become contaminated, crunch substrates, have its bearings seize and get its transfer arms warped if it is stressed in the least.

I then go to my notebook and appear to check a long list of figures before going to the computer and grimacing as I run my finger along some complex lines that have popped up on the screen. I scribble a few things on a piece of paper and then slowly walk back to the section head, being sure to maintain a properly furrowed brow.

I hand the paper to the section head.

"What's this?" he asks.

I've handed him a list of $300,000 worth of gizmos that I want to strap onto to my machine in order to improve its efficiency. Being a good engineer, I know that such money is never available during normal budget projection periods, but can often be *found* during a program crunch.

"This is the bare minimum of funds I will need in order to get the machine to the specs that will be needed to meet the program requirements," I say. This is my first exaggeration with extreme prejudice. My machine could grow the needed wafers that very day without any improvement. But my section head does not know this.

The section head's expression is that of someone who just took a bite from a two-week-old egg-salad sandwich. He scratches his head and tells me that he doubts upper management will be able to scrape up even $200,000, much less $300,000. I just shrug and remind him that this is a $300 million program.

He slowly nods.

Then I give him the *bad* news. *If nothing goes wrong,* I tell him (every engineer worth his socket set will preface a prediction with that clause), I can deliver three wafers a week.

He groans.

How did I arrive at that number?

It was not overly complex.

The other three programs I'm providing for will eat ten wafers a week, leaving me with thirty more I could potentially produce. Knowing my machine, six wafers a week will be toasted somewhere along the process, meaning that I have twenty-four that should be production worthy.

And this is where the calculation becomes tricky.

There are three levels of management between me and the program office. So this is how it works. I tell my section head I can produce three wafers a week. He will tell the department head that if he puts the screws to me he can probably get me to generate five per week, at which point the department head will stomp about and tell him that is totally unacceptable–they will need six wafers a week. But to throw me a bone she will not only provide the capital budget I ask for, but increase it to $400,000. She then goes to the lab manager and informs him of the six wafers that can be generated, all at the cost of $750,000 in capital expense (the additional $350,000 going to operating expenses at the department level).

The lab director screams, a sound which represents the opening volley of negotiations. By the time the smoke clears, nine wafers a week have been promised and $1.2 million will be provided. The lab director drives over to the satellite division to inform the program manager of the wafer status. The program manager then pretends to have a heart attack on hearing the news, requiring the placing of a pill (actually a breath mint) under his tongue and the downing of a slug of cold water brought in by the secretary. Negotiations then proceed. It is finally agreed that ten wafers will be delivered a week and the program director will pitch in $1.5 million.

Hands are shaken.

Each level of management takes its cut of funding, and about a week later I am informed by my section head that, due to his utter brilliance as a negotiator, I will be receiving $600,000 in funding and will have to deliver ten wafers.

I tell him that will be impossible.

He reminds me that he has provided twice the additional funding that I asked. I remind him that the $300,000 was going to get him three wafers a week, so that $600,000 will at best get him only six wafers a week. After intense negotiations he gives me an additional $300,000, money that he will pull back from the funds that had been skimmed by him and the department head, if I deliver eleven wafers a week.

Deal done.

Now remember that I know I can deliver twenty-four wafers a week at no added expense. But being the extraordinary engineer that I am, I have to deliver less than half that number of wafers and get $900,000 for new gizmos to strap onto the machine.

Of course, I will actually deliver thirteen wafers a week and be deemed a hero.

Now I'm a good engineer, but Scotty is the best engineer in Starfleet. He knows exactly how the game is played and never forgets that those who sit in the cozy command center, having coffee brought to them by blond Yeomen in miniskirts, are no different than the upper management found in any company. And just as I discovered, the only way to get noticed, to be a hero, to be deemed a great engineer, is to come through for upper management during the crisis.

But upper management needs to be cultivated–taught their lessons.

And Scotty knows just how to do it.

During the big battle, when the *Enterprise* is outnumbered by attacking Romulan or Klingon vessels and those in command are being bounced about from the left to the right and then from the right to the left, with several even falling out of their chairs, you know that Mr. Scott is going to call up to the bridge. Is he going to tell the captain that the shields are operating remarkably well and that the *Enterprise* can take the pounding for several more hours?

Of course not.

"Captain, the aft shields are failing. One more direct hit and we'll be blown to bits," Scotty will report.

At that moment, Captain Kirk is about to do something brilliant–either pull a tricky maneuver that will forever be referred to as the Kirk-gambit or spring a psychological trap to befuddle the enemy. But in order to pull off this piece of command-magic, those shields will have to hold for at least another ten seconds.

"Reroute power to those aft shields, Mr. Scott," barks Captain Kirk. "Do whatever has to be done to keep those shields up!"

"Aye, Captain," Mr. Scott replies stoically.

And by God, those shields do hold, enabling Kirk and Spock to again save the Enterprise. But we all know who really saved the day–Scotty and his ability to hold those shields together by sheer force of engineering will. Well, that and the fact he held back enough power in reserves to operate another entire starship.

Scotty knows just how to play every situation.

He's never informed the Captain during a high-speed chase that he could probably squeeze another point-five out of the warp engines. No way. Those engines are always on the verge of buckling during the big chase. And would Scotty ever inform the Captain at a critical moment that the dilithium crystals are in great shape, that more matter/antimatter could be poured through them and the energy created could be coupled into the tractor beam in order to deflect that rogue asteroid from crashing into a planet? Of course not. At the drop of a phaser Scotty will be happy to tell you that the dilithium crystals are about to shatter. Of course he's not about to mention anything about that drawer full of spare dilithium crystals he has hidden away in his desk, right behind all those bottles of Romulan brandy.

And then there is the Jeffries tube.

The *Enterprise* is big enough to haul a crew of over 400 people, but was designed in such a way that all critical engineering elements must pass through the walls of a tube that a person can barely squeeze into. Only an ingenious and brave engineer would dare attempt a journey into the Jeffries tube, especially as the *Enterprise* is being buffeted about by some evil alien power and the slightest misstep in the tube would get you fried.

Step back for a minute.

Just who do you think designed the Jeffries tube in the first place?

Engineers, of course. So why would they cram so many critical systems in such an inaccessible, dangerous place? You now know the reason why, and if you suspect that the Jeffries tube does little more than offer access to the ship's microwave oven network, you're right.

So it's obvious that Scotty knows just how to play the engineering game.

And nowhere is this more apparent than with the transporters.

The first thing to notice about the transporters is that no one actually explains how they work. This is a critical element in any engineering design. The fewer people who understand them, the less that is expected of them, and the less apt people are to complain when they breakdown–and of course, only the anointed few of Engineering are allowed to touch them. When something or someone important is going to be transported, it is always Scotty who is at the controls.

So just how do these transporters actually work?

Well, this is what the folks in Engineering claim: the transporter system scans its target, dematerializes it, holds it in a pattern buffer for a moment and then transmits a matter stream out of the buffer and into an annular confinement beam, where it is shot out from an emitter array located on the hull of the ship. Once the matter stream reaches its destination, the annular confinement beam reconstructs the target.

This is what Scotty will tell you.

Of course this explanation is a classic example of exaggeration with extreme prejudice. The crux of the exaggeration lies with the misnomer of referring to what is being transported about as the "matter" stream.

No one in their right mind would ever consider transporting "matter," especially not any engineer worthy of their red uniform. As with so many other things involving the *Enterprise*'s engineering requirements, it comes down to a problem of energy. If you scan and then breakdown a person into small bits of material (which may be molecules, atoms, neutrons, protons, electrons or even quarks), and then shoot this matter stream down to the surface of the planet, you have a huge energy requirement. The transport system has a range on the order of 40,000 kilometers, and it appears that the transmission of the matter stream across that distance is almost instantaneous–as a person is dematerializing on the *Enterprise*, they are also materializing on the planet's surface. Instantaneous transmission is impossible over a finite distance, unless warp principles are applied and the fabric of space-time is compressed in such a manner that the *Enterprise*-to-planet-surface distance is reduced to zero. We have no evidence of that, as the ship does not shift positions as transporting takes place. This means that the fastest a person can be transported is at the speed of light–the upper speed limit in non-warped space. (Of course, when the warp engines are engaged and the geometry of space time is altered, the *Enterprise* can go better than 1,000 times the speed of light, and in later Trek series transwarp technologies are investigated in which infinite speeds are attempted, allowing a ship to go anywhere in the universe in zero time. Though this technique is never fully demonstrated by the Federation, one would assume that there are species which can perform it, such as those from the Q-Continuum).

Because of special relativity effects, as an object approaches the speed of light, its mass increases. In fact, if an object moves at the speed of light its mass becomes infinite, and all the energy in the entire universe would be inadequate to budge it. So let's scale back and assume the matter stream is moving at half the speed of light (under those conditions, the relativistic effects on mass only increase it by twenty-five percent, which for this example can be ignored). Most of us are familiar with Einstein's equation relating the rest mass of an object (m) with the energy (E) represented by that mass through the equation $E=mc^2$, where c is the speed of light (and in this case is "squared," so its value is multiplied by itself). This represents the upper energy limit contained in a lump of any mass. However, when dealing with mass moving at less than the speed of light at a velocity, v, it possesses kinetic energy (E_k) which is expressed as $E_k=1/2mv^2$, a form very similar to that of Einstein's equation. If you are transporting a 100 kilogram person in a matter stream moving at half the speed of light, you plug in the numbers and discover that the energy required to do this is around $1x10^{17}$ joules (that would be a one followed by seventeen zeros!).

The joule is probably not an energy unit that you're used to dealing with. To put it in terms that show just what a tremendous amount of energy this represents, $1x10^{17}$ joules is equivalent to the energy liberated by a four-megaton nuclear hydrogen weapon, or about 200 times more than the energy generated by the atomic bomb dropped on Hiroshima. Put another way, it would be equivalent to the total energy conversion of twelve kilograms of antimatter when it comes in contact with matter. And this is to transport just one person.

Imagine what would happen if the annular confinement beam malfunctions and instead of delivering a person, releases a four-megaton explosion. No engineer would ever agree to operate such a dangerous system.

And fortunately for all concerned, the transport system cannot possibly function in this manner, despite what Scotty and the rest of the engineering folks would have you believe. All you have to do is recall what happened in episode five of the first season, "The Enemy Within." In this episode a transporter malfunction generated *two* Captain Kirks (along with two dog-like creatures). This is impossible if we are to believe that transporters utilize "matter" streams, since there would be no additional matter to create that second Kirk or dog creature.

So what does this imply?

The only obvious explanation is that matter is not actually transmitted during the transport. So what is it that gets stored in the pattern buffer and then gets transmitted through the annular confinement beam? Well, the very name used for the pattern buffer should give you a clue–"pattern." Rather than transmitting mass, what is transmitted is pattern, which is just another name for information, in this case referring to the information representing the object being transported.

Why would Scotty exaggerate the energy requirements for the transporter? Remember how engineers operate. Every time someone beams down or is beamed up, Engineering has convinced everyone in command that operation consumes twelve kilograms of antimatter. If that is not actually needed, then Scotty now has twelve *extra* kilograms of antimatter. He's obviously keeping two sets of books, knowing that the day will come when command believes that the antimatter tanks have just about been drained, and, of course, choose that moment to battle a horde of Klingon ships, telling Scotty that he'll just have to find fuel for the warp drives *somewhere*. Fortunately, he'll still have many thousands of kilograms of antimatter in his secret reserve tanks, just as any good engineer would.

While the hoarding of energy is probably the number one thing that engineers like to hide from upper management (equivalent to excess capacity in its many forms–in my case being the true number of wafers I could produce in a week), there is another item that comes in a close second, and that is computing power. Engineers always need newer, bigger and faster computers, with systems typically obsolete by the time they are installed. This would be especially true for use of the transporters.

Consider the fact that the typical human consists of 10^{28} atoms. As we've seen, the transporter does not actually transport matter, but it will need to transport the information that defines the object being transported, whether it is a pile of bulkhead plates or a Lieutenant Commander. This offers another opportunity for a quality engineer like Scotty to exaggerate just a bit. What he will tell you is that during the scanning process not only will each atom need to be precisely located in three dimensions, but that its energy states, bonding configurations, vibrational modes, nearest atomic neighbor interactions and a whole range of other quantum mechanical characteristics will need to be mapped.

And, of course, each atom will have to be mapped multiple times.

The big problem in measuring the quantum characteristics of a particle is that the act of measuring these properties will often change them (this is an artifact of the Heisenberg uncertainty principle). An example of this principle is that the product of the uncertainty in a particle's position and momentum (defined as the product of its mass and velocity) has a lower limit below which you can't make a determination. For example, the more accurately you define a particle's position, the less accurately you can determine its momentum. The engineers in the *Enterprise* will tell you that this limitation will require multiple measurements by different techniques in order to determine a relative probability for each of these quantum states, and all that data is crunched by what are called the Heisenberg compensators. By the time all this is accomplished, a single atom may well have 10,000 attributes assigned to it.

This means that a person is defined by 10^{32} bits.

The *Enterprise* engineers will gleefully rub their hands together when they consider this number, explaining that using state-of-the-art buffer storage technology–in which storage atoms (where each atom holds a data point) are stacked in a three-dimensional, quasi-gaseous state under extreme pressures, and where the atom-to-atom spacing is only ten Angstroms (consider that a typical atom to atom distance in a solid is about three Angstroms, where 10^8 Angstroms is a distance of one centimeter)–means that the information to represent a person requires the storage volume of a cube roughly ten meters on a side (or thirty feet on a side).

Huge!

So Engineering always needs more storage space, and faster processors to move all those bits into the annular confinement beam. Now, of course, this is the story that the engineers tell command and budgeting personnel. Like everything else, it is just a "wee bit of an exaggeration," to paraphrase Scotty.

The truth is you don't need to map the quantum states of the atoms in a person's body in order to accurately map the person. For example, the computers on the *Enterprise* are more than sophisticated enough to understand the construction of a liver cell, knowing not only where each and every atom should go, but just where each and every one of those liver cells need to go in order to build a healthy liver.

This is an example of data compression in the extreme.

And if for some reason you have a few abnormal liver cells, they will be replaced by the standard liver cell when your transported body rematerializes–and so much the better for you, since any deviations in a liver cell are either incipient cancer cells or inefficiently operating cells. You can think of a transporter ride as a whole body tune-up.

But what about the brain, you may be asking.

What about the brain?

You have about $1x10^{11}$ neurons, and each of them sends out some $1x10^{4}$ dendrites to connect to other neurons (the connections are the synapses). This translates into $1x10^{15}$ connections in your head. A great deal of what you are is represented by how those neurons are connected in that tangled mess, the electrical resistance of the dendrites connecting them and the electric field gradients and specific ions in the synaptic clefts. Let's be very generous and suppose that each synapse will be given 100,000 associated data points in order to characterize how a particular synapse is working. You don't need to know where each atom in the synapse is, let alone the quantum states of those atoms. All you need to reproduce is a synapse that operates like the original synapse–100,000 data points should be more than enough to uniquely define the characteristics that describe the electrical and mechanical characteristics for a single synapse.

So your brain, the part of you that makes you who you are, could be described by $1x10^{20}$ bits. As for the rest of you, that liver and all the other associated parts, even if you needed a billion-billion-billion bits to describe it (which you won't by a long margin), this would only come to an additional $1x10^{18}$ bits. If you add those two numbers together, it means that you can be defined by $1.01x10^{20}$ bits. What that number shows you is that defining the body is trivial as compared to defining the brain, and that you can approximate the information requirements by considering only the brain–$1x10^{20}$ bits. Now, if we use the same storage buffer technology where each stored bit of information is encoded onto a single atom with a nearest neighbor spacing of ten Angstroms, just how much memory space do we need?

It turns out to be a cube with each side measuring only *half a centimeter*.

But of course Scotty has convinced Kirk that he needs a storage buffer in which each side measures ten meters. The reality is that with a storage buffer ten meters on a side, in which each person's data requires only half a centimeter, Engineering could store eight billion people—more than the current population of Earth.

So information storage is no problem.

The last mystery we come to is that of where exactly the mass of a person goes when they are dematerialized, and where the mass comes from when they rematerialize. That, of course, is the real function of the Heisenberg compensators. When a person is being dematerialized, an atom-by-atom scan is performed. We already know that the more exactly we specify an atom's momentum, the less accurately we can determine its position—this is the core of the entire transport system. As each atom's momentum is determined more and more accurately, its position becomes less and less known, with the spooky nature of quantum mechanics allowing the atom to be in multiple locations at once. The Heisenberg compensators push this to such an extreme, measuring the momentum so perfectly that the location of each atom is spread out over a spherical volume with a radius of 40,000 kilometers (this is the same approach used to achieve transwarp drive, in which the wavefunction of an object is spread across the entire universe, then collapsed to the desired destination).

All the transporter operator needs to do is to specify the desired location of these atoms, such as on a planet's surface, and the perfect measurement of each atom's momentum collapses, as the probabilistic nature of the atom is fixed on some point within that 40,000-kilometer sphere.

Transportation completed, the person is reassembled based on the 10^{20} bits in the storage buffer, no H-bomb level energy required and no massive storage volume needed. That's just how simple the transporter really is.

And for the case of those two Kirks, where did the extra mass come from?

As we've learned now, there is nothing really special about the mass used in constructing a person—the Heisenberg compensator just shifts the position of an atom (*any* atom) to the desired location and a person is fabricated. In the case of the second Kirk, the mass came from the waste storage vats beneath the transporter system. (Remember that one of Engineering's many tasks is waste management for the *Enterprise*.) At any given time there is more than enough unwanted mass in the bottom of the storage vats to create any number of extra captains.

But you still may be wondering why one of those Kirks was frightened and weak-willed while the other was a mean-spirited, Yeomanchasing tough guy. There was a transporter malfunction, of course, but not quite the one as detailed in "The Enemy Within."

Engineers love their toys and are always figuring out new ways to play with them. As we've learned, Engineering literally has energy to burn and sufficient storage space to store billions of people. It also has the basic template of every person on the *Enterprise* kept in the storage buffer. Don't shake your heads and tell me that information will degrade in the storage buffer so quickly that you can't keep a copy of a person viable for more than a few minutes (as was done to the Klingons in the seventh episode of season three, "Day of the Dove"). A person's pattern will remain viable for years, even *decades*. But Scotty never lets anyone in command know this, using the buffer's capacity only during a real emergency, such as in the *Next Generation* episode "Relics" (*ST: TNG*, 6-4), when Scotty crash-landed on a Dyson sphere. With no hope of rescue he placed himself in the storage buffer and was rematerialized *seventy-five years later*.

This is undoubtedly one of the many side projects *Enterprise* Engineering was working on. Others obviously included the manipulation of neuron and brain chemistry to alter the personality and abilities of a given person. If a romantic Kirk was needed to woo a female Romulan starship captain, one could be constructed by the transporter. If a brilliant tactician Kirk was needed to figure out how to defeat ten Klingon Birds-of-Prey, with nothing but the ballast blown from *Enterprise*'s waste system, then one of those could be constructed as well. Obviously Scotty's engineering had been experimenting with a whole range of Kirk replacements.

Why?

Because Kirk always insisted on being on that first landing party, the one where one-out-of-five transportees would be killed within the first minute of hitting the planet's surface. The odds are one-out-of-five, and despite the fact that Kirk must have beamed down over a hundred times, he was never killed.

Or so they'd like you to think.

No, Kirk was in fact killed on average during every fifth landing, just as Spock and McCoy were. What Engineering would then do was beam the survivors immediately back up, reconfigure synapses in order to remove the memories of the last few seconds in which a command person was killed and then send them back down to the planet along with a slightly altered version of Kirk–one less likely to get killed again in that situation.

It all makes such perfect sense.

It's what any good engineer would do. If you make sure you've got spare energy, spare shield reserves, spare buffer memory and spare warp performance, you'd naturally want to have at least a few spares of critical personnel.

Scotty is definitely *the* man—without him, Kirk, Spock and Bones would have all been killed well before the first season was half over, and the ship would have been destroyed either by a warp core breach, buckled shields or other-dimensional waste spewing from toilets.

If I'm ever offered that trip on the *Enterprise*, I'm staying close to Scotty.

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