Employee Training and Development with Standard Operating Procedures

Third Edition

How to write mistake proof job procedures, work instructions and inspection and test plans that deliver world class work quality every time.

Realise and release across your organisation the continuous improvement power of error proof Standard Operating Procedures.

By Mike Sondalini

Preface to the Third Edition

The third edition of the book you hold is for your education and guidance. It will help you to greatly improving work outcomes by reducing the chance of making errors. If there was a sure way to stop mistakes we would already all be using it and we would be happily living in a world where no errors occur. That is clearly not the case, but a simple thing can be done to vastly improve the situation—use the 3Ts[1] in all your written instructions and workplace training. The 3Ts is an error proofing and mistake proofing technique that has reduced error rates by 10,000%.

The Accuracy Controlled Enterprise 3T technique of work quality control is a powerful mistake proof method that improves the outcomes in every situation where humans are involved. A 3T designed document uses system reliability principles to build work instructions that produce extremely low error rates.

This edition includes the use of checklists as a practical application of error proofing to confirm an activity has been done. As well as rewriting and updating sections of the book with the latest information, this third edition of Employee Training and Development with Standard Operating Procedures introduces a complete explanation of how the 3T method of mistake proofing work activities provides statistical process control to human work tasks. It details the use of two-sided quality limits that specify both world class performance and just passable performance to encourage high quality work outcomes. Useful explanatory diagrams have been added to the book to aid in illuminating various concepts and principles.

I hope that with this book in your hand as your guide you will firstly come to understand the process control benefits and psychological concepts behind the 3T error proofing methodology. Secondly, that you gain the confidence to experiment and trail the technique in your workplace in your most troublesome situations. Finally, that you gather the evidence, and thereby gain the belief you need, to make ACE 3T standard operating procedures the only way to control the work done throughout your business, departments and workplaces.

Mike Sondalini
May 2011

[1] 3T is Target – Tolerance – Test used to control the accuracy of each activity done in a work task.

Preface to the Second Edition

During World War II British airmen referred to ongoing trouble with aircraft, in spite of aircraft mechanics' best efforts, as ‘gremlins at work’. A gremlin is an imaginary creature that lives inside machinery and equipment causing trouble in devices and systems of all kinds. The gremlins are us.

Unless we are saboteurs none of us intentionally cause problems. Yet why do problems happen so regularly and, in far too many cases, so disastrously? The ‘human element’ is recognised as the single most uncontrolled cause of failure[2]. People cause most problems. The ‘human element’ is the uncertain, random nature of outcomes from peoples’ actions and behaviours. Our technology has advanced the quality and properties of materials, equipment and machines to the point that they are highly unlikely to fail by themselves[2]. It is people that cannot be controlled, it is people who take on tasks they are incapable of doing well or who are incompetent in their jobs. When things go wrong it’s most likely the ‘human element’ at work; we gremlins.

It has long entranced me as to what can be done to address the ‘human element’ in causes of failure; how can luck and chance, ignorance and incompetence, be turned into certainty of quality results. I believe the answer is surprisingly simple—describe exactly what world class performance looks like when doing a job. This means specifying the range of outcomes that are acceptable when doing a task so that the person doing the work has the best chance to get total control of what they do.

We call people ‘expert’ when they skilfully apply knowledge and method to deliver the right results. An expert does their work right the first time because they control it with great certainty to deliver the needed result. This definition of ‘expert’ gives us hope for solving the problem of the ‘human element’. If people can become ‘expert’ they will do their work right and mostly without error. Everyone needs to be expert at their job. We all count on it. In a company of ‘experts’ all work is controlled to the highest probability of being done right the first time.

Experts focus on failure prevention and defect elimination to ensure their work is done right first time. They do not want to fix problems; rather, they put their effort into not having problems. They know that making mistakes, or doing work wrongly, is too wasteful and expensive in time, money, energy and resources. Experts do not repeat a job; they do it right the first time. Being expert is far from simple. Today there are far too few experts in the world and this book was written to help fix that problem.

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[2] Barringer, H. Paul P.E., Conference paper - *Use Crow-AMSAA Reliability Growth Plots To Forecast Future System Failures*, 2006

We need everyone to be expert at what they do if the frequency of failure in our businesses is to be reduced. The second edition of this book takes the 'target and test' method used in the first edition and improves it to more surely and quickly develop expertise in a job. As in the first edition the focus is on finding and using the hidden power of standard operating procedures to deliver quality output faster and with great certainty of success. The 'target and test' method now has tolerance bands about the target, as with an archery board, to make work a challenging, fun game that urges us to become expert faster.

To help explain the value and use of well constructed SOP's this edition includes new information on the causes of failure. It also includes new information on the reliability of human workmanship – we are not machines and 'failure' is often not a person's fault but is caused by poorly structured work and poor workplace environments condoned by management. A most beneficial inclusion in this edition is a new development to encourage the rapid creation of high skills and abilities throughout an organization. It is called the '3T failure prevention method' – 3T stands for 'Target, Tolerance and Test'. You will learn how to incorporate it into SOPs so that work quality sky-rockets as people quickly become highly skilled. Another addition worthy of mention is a revised way to layout SOPs horizontally for Value Stream Mapping to drive continually improve in job performance by identifying wasted time and resources.

The last major inclusion in this edition is to present the simplest corporate quality performance improvement program known. The Accuracy Controlled Enterprise, or ACE, represents an ideal to strive for in running organizations. Much simpler than establishing a quality management system like the ISO9000 series, or introducing Lean or Six Sigma, it still drives the achievement of excellence by focusing on improving individual performance. An ACE uses 3T failure prevention methodology in every task at every level of the organization. The Board members, CEO and senior managers lead from the front by first applying 3T rigor and VSM Kaizen SOP continuous improvement in their work to become 'experts' in their duties. Once they deliver 'expert' performance they cascade the 3T/Kaizen SOP concepts to middle management and the workforce. The ACE approach delivers quality by ensuring the knowledge, skills and methods are present in the right people, at the right time, to delivery expert accuracy. In an ACE everyone is an expert at their job and as a consequence the organisation cannot help but outperform the competition.

This second edition presents you with information on the best SOP methods yet devised to detect and stop errors in business processes – the Accuracy Controlled Enterprise, 3T failure prevention SOPs and Value Stream Mapping Kaizen SOP layout. Together they prevent failure, eliminate

defects and deliver quality performance faster by ensuring all work is done accurately the first time. With them in place, and in use, a business has the simplest quality system around to get maximum profits and customer satisfaction from the efforts of its people. The new methods of developing standard operating procedures shown in this book will help your organization to become the best and most expert in your industry, fast.

One final indulgence is to thank my wife and children for their years of patience with me. (Only an author and their family would know what I mean.)

Mike Sondalini
July 2007

Preface to the First Edition

This book is more than a 'how to' manual on writing Standard Operating Procedures. With this book you can take a new employee, or a poor-performer, and turn them into a successful, productive worker faster than any other way known to the business world. You will be astounded at their progress.

There is great power in a standard operating procedure or work instruction. It is the perfect training and development tool for mastering established jobs. With them you can continuously improve people's performance. Within 24-hours you can turn a poor performer into a master of the job! A standard operating procedure (SOP) gives total control over what a person learns. From the finest details, the most exact measurements, the most perfect of actions, a SOP can guide them all. Beyond personnel development, work control and setting standards, a SOP has another, perhaps more important role which is missed by many – it contains the total organizational knowledge base on that task. The secret power of a SOP, or work instruction, is the years of training, know-how, experience, learning, testing, research and discoveries imbedded within it. They are the working intellectual property of a business. They reflect the progression of many people's learning since the first version was written. Today's SOP should contain the best, fastest, most sure ways to successfully do a job. When you start new people, train them in all the experience of those that did the job before them.

A library of SOP's will make employee's working lives a breeze. They will consistently and reliably, produce the results that you want. You will gain belief and confidence in using SOP's when you read the case study in this book. You'll read how a SOP turned a difficult, seeming lost situation into the most productive result possible for the organization and the worker. Years of expertise and continuous improvement are forever captured in a SOP. With it people self-learn, self-manage, self-correct and successfully complete tasks unsupervised. Without a standard operating procedure, or work instruction, things are open to interpretation and guesswork, and many unnecessary problems will result! All of which takes someone's time (probably yours) to correct.

When a SOP is well written, and continually updated with the current best practice, you have a most powerful way to provide training, development, mentoring, guidance and certainty of job success.

Mike Sondalini
2004

1. A Clear Path to World-Class Performance and Results

In this book you discover a very simple and most-certain way to become a world-class performer. You will learn how to always get top-class results in everything that happens in your department and business. It was not until reliability mathematics was identified during World War 2 that it became clear how to get 99.9999% perfect results every time. Even then the complicated statistical and probability formulas were only used to design rockets and jet aircraft. With the creation of ISO9000 quality management system in the early 1980's it was recognized that reliability mathematics principles also applied to people-centred processes.

You can become world-class in your industry within a matter of months. It can be done when you build a process to produce that result. The people that tell you it takes years to reach world-class, work performance in business processes are not aware of any other solutions. How to quickly become the best operation in your industry is very clear and straightforward – become an Accuracy Controlled Enterprise by using reliability principles to produce error-free performance from every process and person. What you need to do is revealed and explained in this book. Becoming world-class at any task is now formulaic and you and your people can rapidly be an Accuracy Controlled Enterprise (ACE). There are stringent requirements to adopt, but they are not difficult to do.

1.1. The Journey to World Class Quality

For millennia the human race has endeavoured to control the quality of workmanship. How well a job is done has always been a concern because of the sad consequences and disasters that result when work is poorly carried out. In times past those that were good at their jobs were known as master craftsmen and they were asked to pass on their skills and knowledge to others. Traineeships and apprenticeships were entered into to teach the right and proper skills to newcomers in a trade or profession. Skills were taught by learning them at work under the tutorship of highly experienced artisans. In more recent times formal schooling was introduced to ensure consistency of training and to provide a means to bring every learner up to a minimum level of performance.

During the 1980s and 1990s investigations were undertaken into the error rate of work. A pattern emerged that identified what needed be done to reduce errors. Figure 1.1 shows what was found.

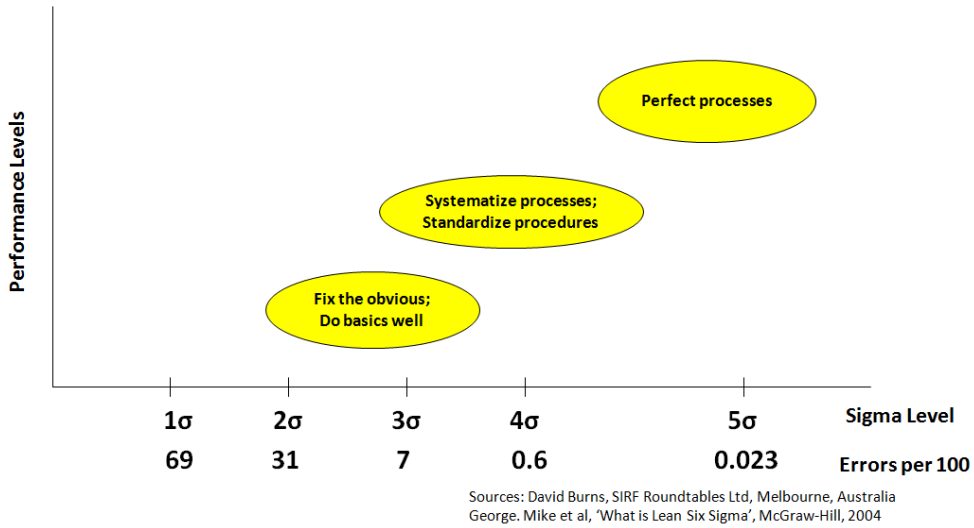

Figure 1.1 Error Rates by Degree of Work Quality Control

Figure 1.1 explains the sad reality that unless you purposefully create standardised systems, processes and methods you will always have high failure rates and poor performance. The typical failure rates in businesses using common work practices range from 10 to 30 errors per hundred opportunities. The best performance possible in well managed workplaces using normal quality management methods are failure rates of 5 to 10 in every hundred opportunities. These outcomes are the natural result of the quality processes used. Even with highly experienced and able people doing the work you will get excessive rates of failure. Letting people work from experience and knowledge always creates unwanted random variation that too often produces wrong outcomes.

To reduce human error it is necessary to prevent variation in work quality. This is achieved by first standardising tasks so that there is only one way that a job and its activities are done. You then make the work process systematic so that it is clear and easy to do and as a result you also get productivity improvement. The standardising and systematising of work delivers both fewer errors and better work performance. This is what the aircraft manufacturing industry has done to drive down the failure rate of flying. Both Boeing in the USA and Airbus in Europe supply all aircraft buyers with manuals that dictate exactly how to use and care for their planes. World-wide the airline industry is regulated to use only the maintenance manuals and systems developed by the aircraft manufacturers. In every country there is one way, and only one way, to maintain an aircraft—the way specified and continually improved by its maker.

Imagine how high the aircraft accident rate would climb if aircraft were maintained at the whim of an aircraft mechanic. If there were 100,000 aircraft mechanics around the world and each was allowed to do their work as they thought best there would be 100,000 personalised ways to rebuild

an aircraft. It is impossible to have 100,000 correct ways to properly build an airplane. There is only one best way to do any job. If every aircraft mechanic rebuilt a plane as they wish we would see a massive increase in flight disasters because there would be a huge variation in work quality. The failure rate of airplanes is as low as it is today because everyone in the aircraft industry has standardised and systematised their maintenance work processes down to one only way to rebuild planes. The right way is controlled and managed by the maker of the plane because they are the only ones that fully know how and why a plane is built as it is. Everyone else meets their standards.

As well as having a standardised work process, every aircraft mechanic is trained and skilled in doing the work correctly. To become an aircraft maintenance mechanic you must read and speak English fluently (English is the universal language spoken in the airline industry in order to reduce the chance of confusion). You must be licensed to work on an aircraft to a high standard of workmanship. Aircraft mechanics cannot maintain a plane unless they have proven, by passing certified tests, that they know exactly how to build that model of plane correctly to the required design specifications. The aircraft industry has gone to extraordinary ends to minimise the chance of error affecting the safety of airplanes. The same philosophy needs to be adopted by everyone who wants to markedly reduce error rates.

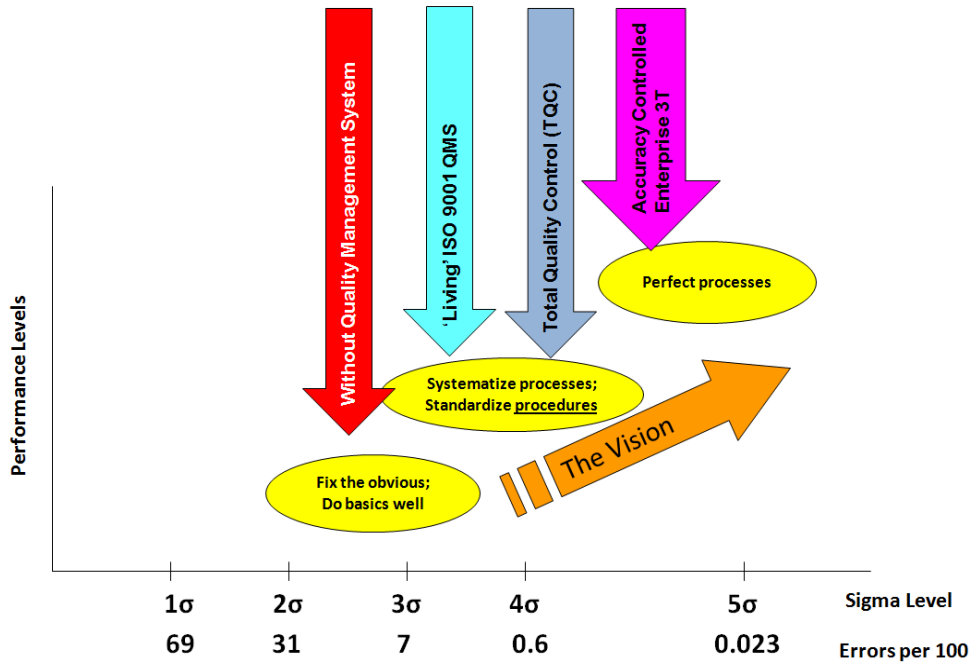

Figure 1.2 Work Quality Control Methods used to Reduce Error

Figure 1.2 overlays the various quality management techniques developed over the last few decades. Since the 1920's, when aircraft manufacturing boomed, there has been great strides made in developing work quality control methods. From simply using highly skilled people in engineered

and designed work processes, like automated production lines, quality management was introduced through quality inspection of completed jobs. Later, statistical control of work processes was added, in which failure rate data was collected and investigated so that the work process design could be corrected and improved. Once the work process design was fine-tuned, improvement efforts focused on building quality into the product instead of inspecting it in by having it pass set specifications. the 'human element'. It is now clear that people are the greatest remaining cause of failure by far. Efforts are now underway to help people do great work and ACE 3T is the culmination of all past efforts at human error prevention.

1.2. A Bus Trip Analogy

Let us start investigating human error prevention by understanding a simple, but very important, reliability concept—the chance of failure. You do not need to know about reliability; the concept is easily explained with a story of a bus trip.

Say that it is the first day of a new job and you need to get to your new workplace by bus. You have thought the trip through in your head. Get up at 6.30am and get organised for the day. Leave home 7.30am and walk 150 meters to the corner bus stop. Catch the 7.45am Number 32 bus to the city. After a 30 minute ride get off at the city stop and walk 100 meters to the office. Finally ride the lift to the tenth floor and meet your new employer at 8.30am. The plan is practical and simple. You can do the trip in less than an hour and be there well ahead of time. But it is here that we all make the same mistake—it is only simple and certain if everything goes right.

Let's make a picture of the bus trip as a process of the activities needed to complete it. Figure 1.3 is a flow diagram of the bus trip (Reliability Engineers call it a reliability block diagram).

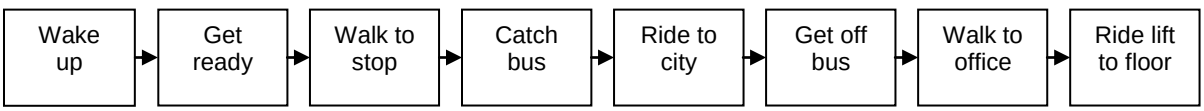

Figure 1.3 Series Process of Steps in Getting to Work by Bus

The bus trip has eight steps in it; each sequential step is done after the previous step is finished. This arrangement is known as a series process. Each step has to go right for the whole trip to go right. If one step goes wrong, the whole trip goes wrong and you don't get to work on time. It would not be a good way to start a new job.

Figure 1.4 shows you the problem when things are arranged in series—there is only one right way to make or do the thing and every other way is wrong. In the case of Figure 1.4 there are 40,320 ways to wrongly assemble the eight nuts on the bolt items. The longer the chain of items the more the opportunities there are for something to go wrong.

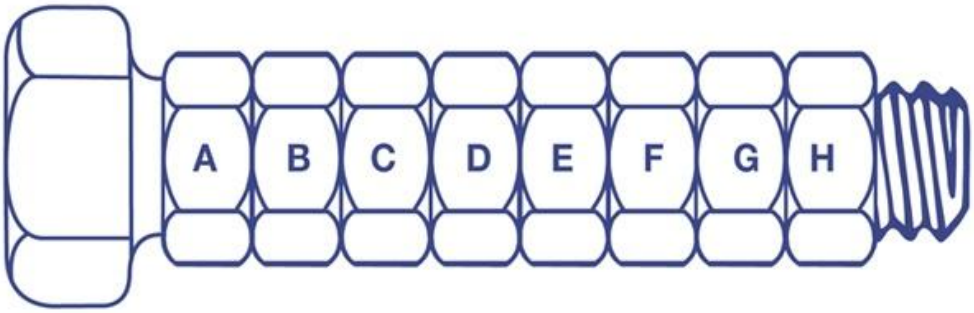

Figure 1.4 Series Arrangement of Parts

In every business there are processes, people and machines. All our business processes are series arrangements of jobs. Every job we do is a series arrangement of tasks. All our production and industrial plants are a series arrangement of equipment. Every machine we build is a series arrangement of parts. Series configurations are at high risk of failure because it only takes one mistake and the purpose or use of the whole system is botched.

In your business you have work processes. These are described in your standard operating procedures (if you have them and they are current). Each work process contains many steps done in a sequence. When a work process step suffers a failure the whole job is failed. For example, if the wrong number is keyed into a computer, that error moves throughout the business until it causes a problem. At which point someone will need to stop their normal job and go and fix the problem by correcting the number. You just have to hope that no major losses occur to the business before the error is found and corrected. All businesses have jobs comprising a number of tasks in sequence, like the arrangement shown in Figure 1.5.

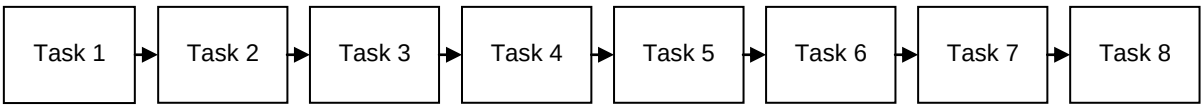

Figure 1.5 All Jobs in a Business Process are a Series Arrangement of Tasks

Your machines are made of parts working in series, one after the other. In some machines there maybe a few parts, in others there may be hundreds of parts needed to run the machine. In a few machines, like a space rocket or a newspaper printing press, there are thousands of parts. Machine

parts work in series and when a part fails, like Part 6 in Figure 1.6, the whole system of connected parts is also failed. Many times this translates into a complete machine failure, or equipment breakdown. The more machines you have in your business, the more parts there are, and the more likelihood that from time to time a few of those parts will fail and stop the process.

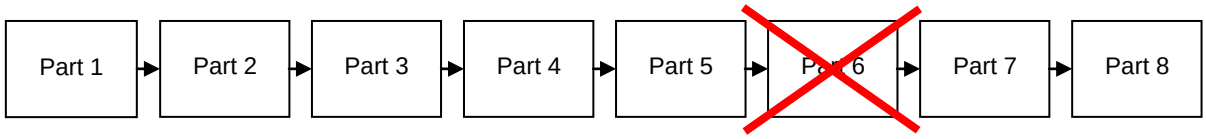

Figure 1.6 One Failure in a Series Arrangement causes the Whole System to Fail

A common example of a system of parts in series is shown in Figure 1.7 for an AC electric motor drive end bearing. A system of parts working together is called a machine. The operation of the bearing arrangement is described logically in the partial reliability block diagram for the drive end. The AC motor is a series arrangement of dozens of parts. We are only looking at a small group of parts at one end of the whole assembly. This how every machine is built—a series of parts.

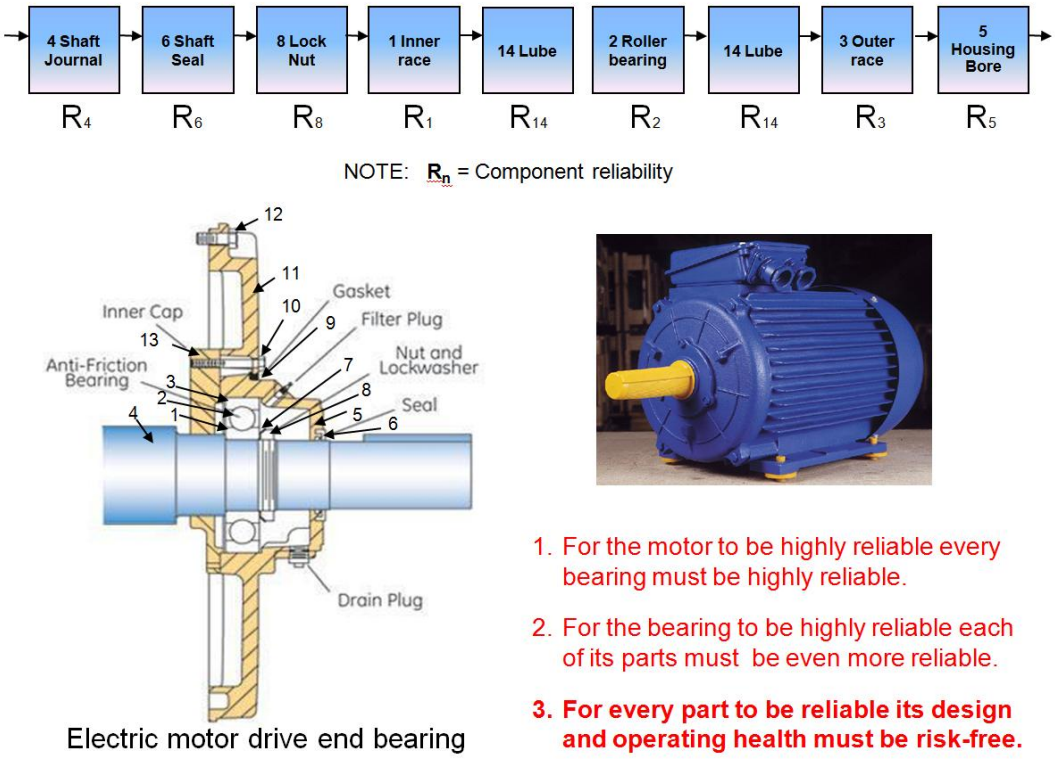

Figure 1.7 Electric Motor as a Series Arrangement of Parts

In Figure 1.8 the car mechanic is doing a twelve task job that is a series work arrangement. Like the chain of parts in a machine, a job is a chain of tasks. Do any task poorly and the job goes poorly. Do any task wrong and the job is a failure.