

## Understanding How to Use The 5-Whys for Root Cause Analysis

### Abstract

*Understanding how to use the 5-Whys for Root Cause Analysis.* The 5-Why method of root cause analysis requires you to question how the sequential causes of a failure event arose and identify the cause-effect failure path. ‘Why’ is asked to find each preceding trigger until we supposedly arrive at the root cause of the incident. Unfortunately it is easy to arrive at the wrong conclusion. A Why question can be answered with multiple answers, and unless there is evidence that indicates which answer is right, you will most likely have the wrong failure path. You can improve your odds of using the 5-Why method correctly if you adopt some simple rules and practices.

**Keywords:** Five Whys, Root Cause Failure Analysis, RCFA, cause-effect tree, Fault Tree Analysis, FTA

The Five Whys approach to root cause analysis is often used for investigations into equipment failure events and workplace safety incidents. The apparent simplicity of the 5-Whys leads people to use it, but its simplicity hides the intricacy in the methodology and people can unwittingly apply it wrongly. They end up fixing problems that did not cause the failure incident and miss the problems that led to it. They work on the wrong things, thinking that because they used the 5-Whys and the questions were answered, they must have found the real root cause.

### Description of the 5-Why RCFA Method

The 5-Why method helps to determine the cause-effect relationships in a problem or a failure event. It can be used whenever the real cause of a problem or situation is not clear. Using the 5-Whys is a simple way to try solving a stated problem without a large detailed investigation requiring many resources<sup>1</sup>. When problems involve human factors this method is the least stressful on participants. It is one of the simplest investigation tools easily completed without statistical analysis. Also known as a Why Tree, it is supposedly a simple form of root cause analysis. By repeatedly asking the question, ‘Why?’ you peel away layers of issues and symptoms that can lead to the root cause. Most obvious explanations have yet more underlying problems. But it is never certain that you have found the root cause unless there is real evidence to confirm it.

You start with a statement of the situation and ask why it occurred. You then turn the answer to the first question into a second Why question. The next answer becomes the third Why question and so on. By refusing to be satisfied with each answer you increase the odds of finding the underlying root cause of the event. Though this technique is called ‘5-Whys’, five is a rule of thumb. You may ask more or less Whys before finding the root of a problem (there is a school of thought that 7 ‘whys’ is better; that 5 ‘whys’ is not enough to uncover the real latent truth that initiated the event).

Implied in the Five Whys root cause analysis tool, though not often stated openly, is the use of a cause and effect tree—known as a Why Tree. The method is also called Fault Tree Analysis. It is best to build the Why Tree first so that the interactions of causes can be seen. Sometimes only one cause sets off an event, other times multiple causes are necessary to produce an effect. The Why Tree for even a simple problem can grow huge, with numerous cause-effect branches.

The 5-Why method uses a Why Table to sequential list the questions and their answers. Table 1 is an example of a completed 5 Why Table for a late delivery that lost a company an important Client.

<sup>1</sup> Some contents for this topic are from the website <http://www.isixsigma.com/library>

Note how each answer becomes the next question. It is vital that each Why question uses the previous answer because that creates a clear and irrefutable link between them. Only if questions and answers are linked is there certainty that an effect was due to the stated cause and thus the failure path from the event to its root is sure.

<b>5 Why Question Table</b>			
<b>Team Members:</b>		<b>Date:</b>	
<b>Problem Statement:</b> On your way home from work your car stopped in the middle of the road.			
<b>Estimated Total Business-Wide Cost:</b> Taxi fare x 2 = \$50, Lost 2 hours pay = \$100, Order was late to Customer because Storemen did not get to work in time to despatch delivery and Customer imposed contract penalty of \$25,000, Lost Customer and all future income from them, estimated to be \$2Million in the next 10 years.			
<b>Recommended Solution:</b> Carry a credit card to access money when needed.			
<b>Latent Issues:</b> Putting all the money into gambling shows lack of personal control and responsibility over money.			
<b>Why Questions</b>	<b>3W2H Answers</b> (with what, when, where, how, how much)	<b>Evidence</b>	<b>Solution</b>
<b>1. Why</b> did the car stop?	Because it ran out of gas in a back street on the way home	Car stopped at side of road	
<b>2. Why</b> did gas run?	Because I didn't put any gas into the car on my way to work this morning.	Fuel gauge showed empty	Contact work and get someone to pick you up
<b>3. Why</b> didn't you buy gas this morning?	Because I didn't have any money on me to buy petrol.	Wallet was empty of money	Keep a credit card in the wallet
<b>4. Why</b> didn't you have any money?	Because last night I lost it in a poker game I played with friends at my buddy's house.	Poker game is held every Tuesday night	Stop going to the game
<b>5. Why</b> did you lose your money in last night's poker game?	Because I am not good at 'bluffing' when I don't have a good poker hand and the other players jack-up the bets.	Has lost money in many other poker games	Go to poker School and become better at 'bluffing'
<b>6. Why</b>			

Table 1 A 5-Why Analysis Question Table

**Build the Why Tree One Cause Level at a Time**

Many people start into a 5-Why analysis by using the 5-Why Table. With each Why question they put in an answer and then ask the next Why question. This question-and-answer tic-tac-toe continues until everyone agrees the root cause is found. Forgotten is the fact that an event can be produced by multiple causes and multiple combinations of causes. Using the Why Table alone is permitted if there is only one cause of every effect listed on the table.

The logical connectivity between events and all their causes can be seen with a Why Tree. Building a Why Tree gives you a good chance of spotting all the issues that could have been in play prior to a failure event. By only asking Why questions without the Why Tree to guide you, you may never find all the real root causes. Questions can always be answered, but that does not mean that the answer is right, or that all necessary causes of the problem are identified. It is unrealistic to do a 5-Why analysis by only completing a Five-Why Table of questions and thereby expect to arrive at the real root cause just because the questions were answered. First you must draw-up the Why Tree one level at a time and ask the 5-Why question for each level to find the real failure path through that level of causes.

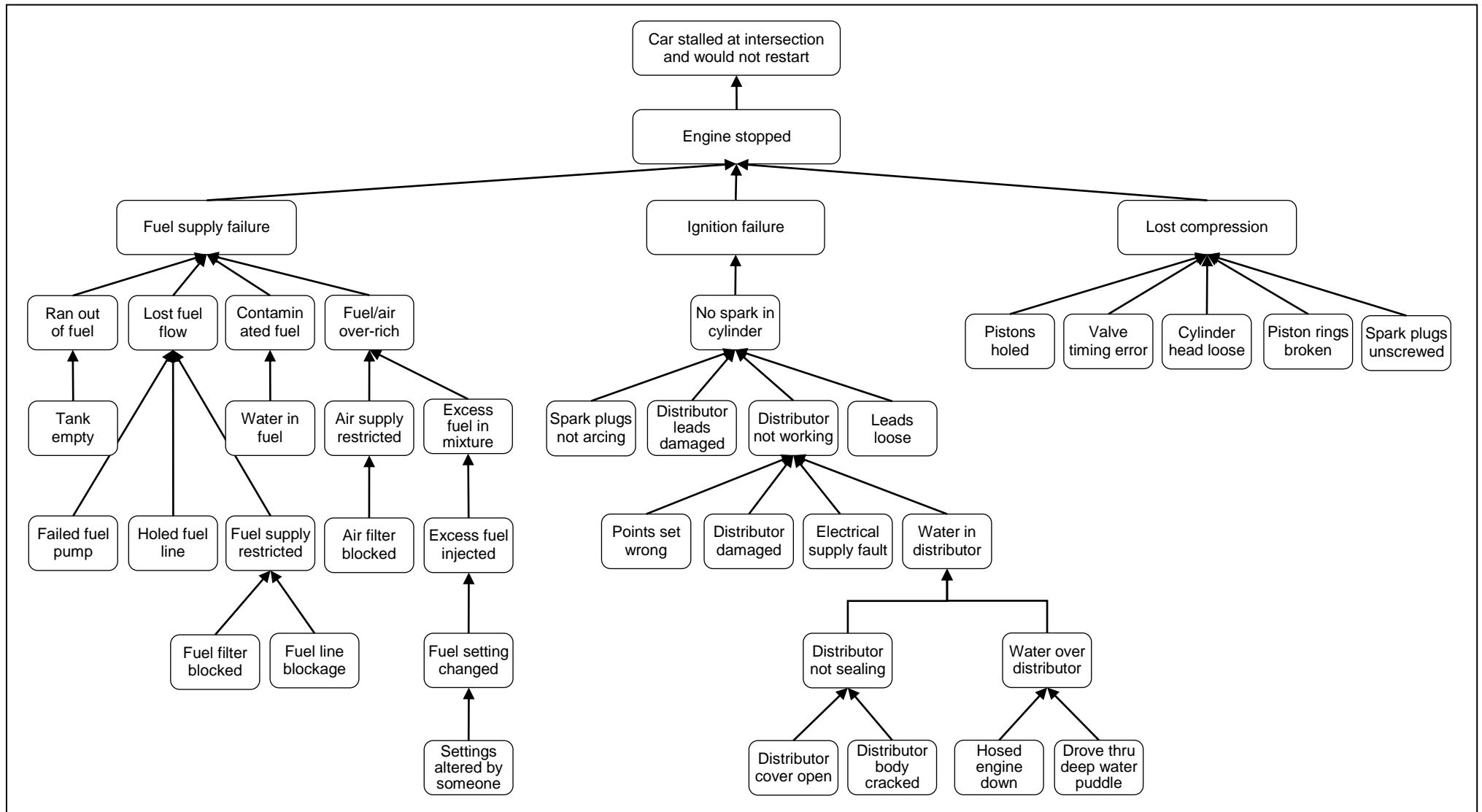


Figure 1 Partial Why Tree of Passenger Car Engine Failure

Figure 1 shows a partial Why Tree for a stalled car (the complete Why Tree would be a monster). The analysis team uses their collective experience and knowledge of the causes of a stalled car to logically develop the first level of the Why Tree. Once we identify all the possible first level causes of the problem we then ask the Why question to find the real first level cause.

A passenger car can stall from electrical system failure, OR from fuel system failure, OR by loss of engine compression. Each cause is presumed independent of the other and so the connections to the top failure event are known as OR gates. For each of the three causes we can set off and develop the next layer of causes. After the second level of causes we can image third level causes for each one of them. After the third level we build the fourth level, and on and on and on we can rush until there are many branches, with dozens of boxes in our Why Tree of the causes and effects. If you did that you will have wasted a lot of people’s time, thrown away your business’ money, and almost certainly you have the wrong root cause.

It is wasteful of time and people to build an entire Why Tree of a failure incident in the first meeting unless all the evidence is known down to the true root cause. Figure 1 shows the top of a Why Tree with three branches going towards possible root causes. Two of those branches will prove to be unnecessary and their development is pointless. At each level the true failure path should be identified by the evidence and the other possibilities eliminated. There is no value spending time in a 5-Why failure analysis developing branches that did not cause the top failure event. (If you were conducting a risk analysis, and not a failure analysis, you would develop all the branches.)

The approach to take with a 5-Why root cause analysis is to start the Why Tree with the top failure event and identify all first level causes. Use the evidence and logic to prove which one(s) brought about the incident. Once the first level cause(s) are confirmed you tackle level two causes and confirm which of them produced the level one effects, and so on. In Figure 2 the first Why question to ask is, ‘Why did the car stall?’ The answer is the engine stopped working. The believable evidence is that the engine would not restart. The level two question becomes, ‘Why did the engine stop working?’ A critical component failure in any of the three systems that allow an internal combustion engine to work—electrical, fuel and mechanical—will stop the engine.

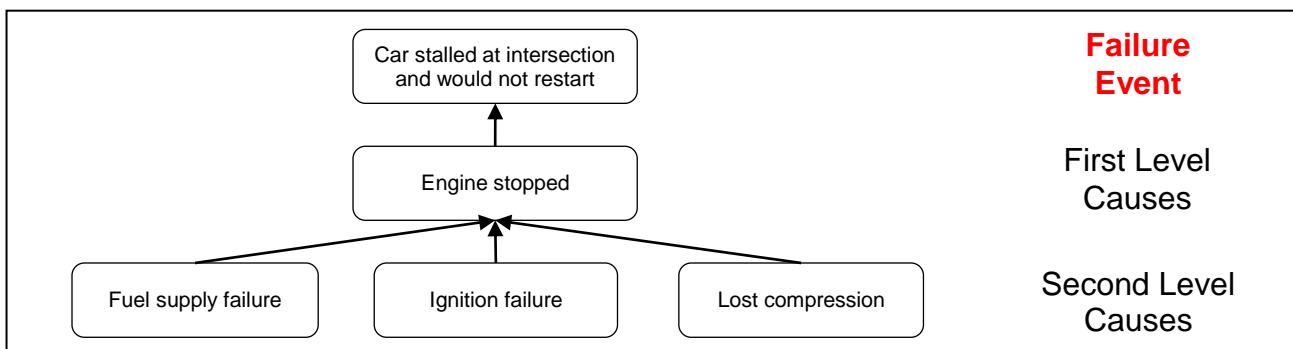


Figure 2 First and Second Level Failure Causes

At level two there are three reasons as to why the engine did not work. You must not ask a third level Why question until you know the right answer to the level two question. Your 5-Why analysis must stop here pending sure evidence as to which path the root cause belongs to. Most people using the 5-Why method will expect the team conducting the Five Why analysis to collectively select the cause of the engine stoppage. But there are three possible paths to take, only one of which is the right one (presuming that there was no interaction between systems in causing the failure event). If you accept one of the level two causes as an answer without having sure

evidence you are guessing. If you guess, I have no sympathy for what later happens to you and the analysis. It is just plain wrong to accept any answer to the Why question—only with real evidence or impeccable logic can you know the true cause. If you have sure evidence then you and the analysis team will know the right answer to the level two question. If you do not have true evidence you will direct people on the team to go and investigate the event and come to the next meeting with hard facts so that the true failure path can be identified.

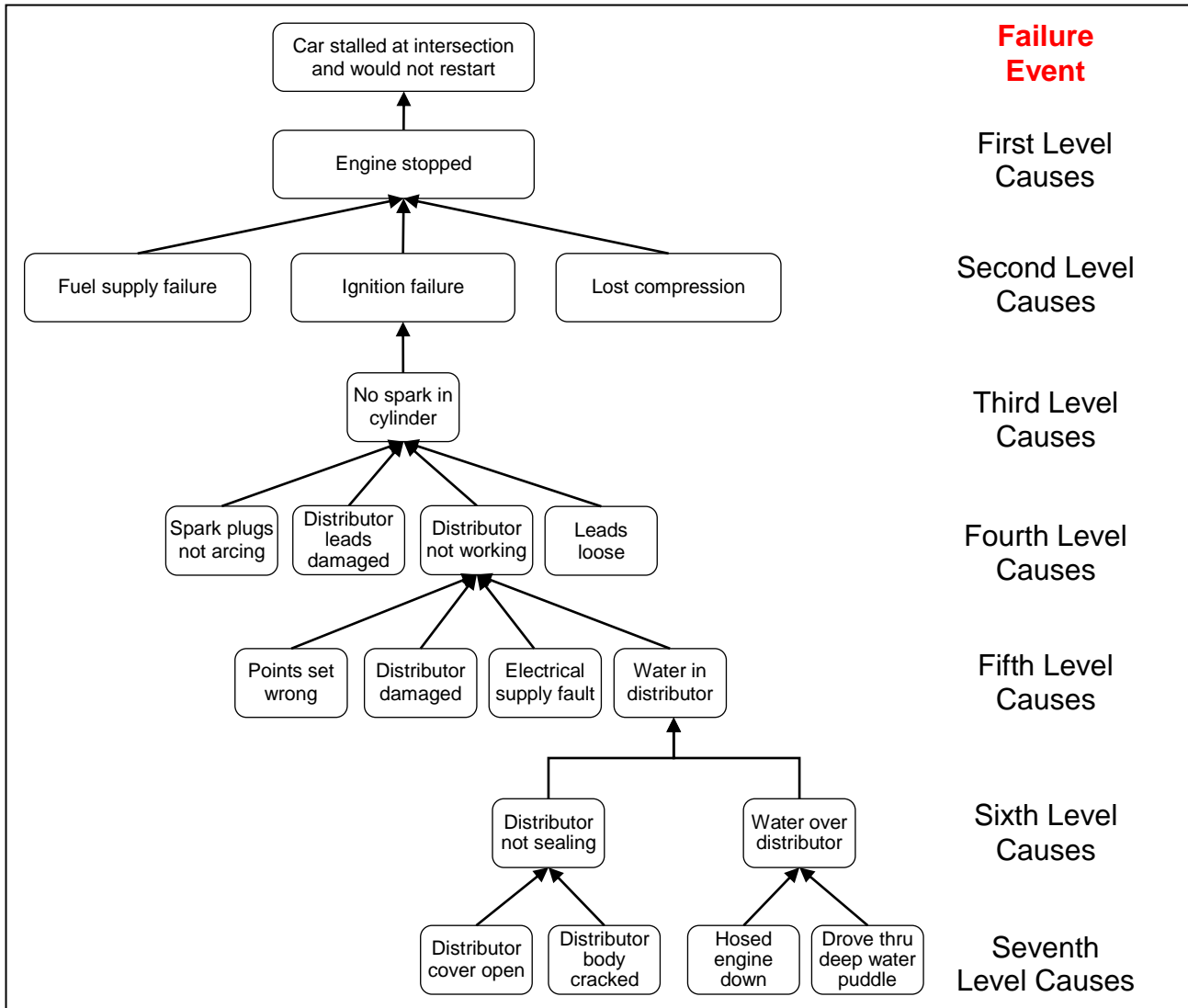


Figure 3 Levels of Failure Causes

You use the evidence as the proof test to confirm the cause(s) for every level in the Why Tree. The evidence alone confirms the path to follow. Impeccable logic that withstands scientific scrutiny can also be used to identify the failure path. As you work your way down the cause and effect Why Tree you accept only the answers that are proven by sure, true evidence and/or unquestionable scientific logic. It is evidence and/or clear logic that decides the path to take, not someone's opinion. We fill-in the Why Table as each cause level event(s) is confirmed. In Figure 3 the Why Tree has gone down to a 7-Why level. There are many questions to be asked and answers to be proven. If you do not have true answers for each level, immediately stop the analysis and send the team out to investigate and find the facts. It is only with accurate hard evidence that the real causes and circumstances are certain. With real evidence and sound logic you know the causes are true.

### Select Your Starting Question From Well Up the Why Tree

If you select the top failure event too low down the Why Tree you may not find the true root cause. Had the top failure event been the engine would not go, and we asked the first Why question as, ‘Why did the engine stop working?’ you would have made an assumption that the car stalled because of an engine problem. You can also stall a car by running into the back of the car in front of you and damaging the engine.

It is vital to start high up the Why Tree when you ask the first Why question. Figure 4 shows by setting the top failure event as the stalled car, and asking the first question as, ‘Why did the car stall?’ it ensured that all other causes of stalled car engines were eliminated by the evidence. There was no car accident, so logically the stalled engine had to be due to a problem with the engine itself.

It is better to start well up the Why Tree and ask a few unnecessary questions that are easily answered, than start too far down and totally miss the real cause and effect path of the incident.

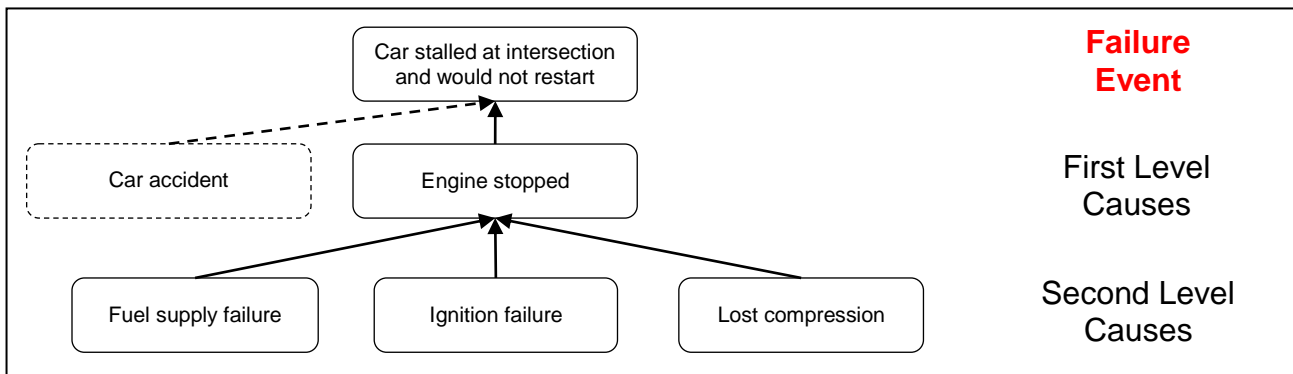


Figure 4 Importance of Starting with the Right Why Question

### How to Handle AND Gates in a 5-Why Analysis

Many failure incidents require multiple causes to happen together to trigger the next level event. A fire needs fuel, oxygen and an ignition source, all three must be present simultaneously. On a Why Tree for a fire you will always have the configuration shown in Figure 5, with Fuel AND Oxygen AND Ignition present. In the Why Tree the three must be shown acting together to cause the higher effect—they produce an AND situation gate.

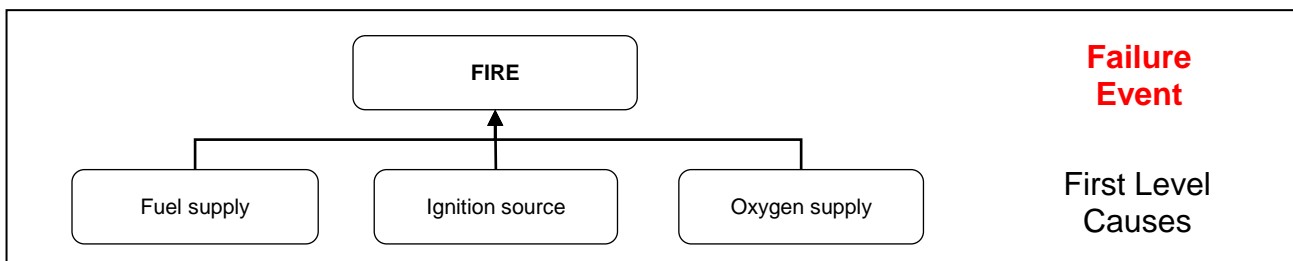


Figure 5 AND Gate for a Fire

In Figure 6 there are two necessary joint causes of ‘water in distributor’ which form an AND gate—both must have happened for the next higher level event to occur. For water to be in a distributor there must have been an opening of some type and there must have been water flowing over the distributor body to go into the distributor. Unfortunately, a standard 5-Why question table does not

let you recognise when AND gates exist. Since an answer is used to create the next question they can link just one cause to each effect. Why Tables used alone will make you follow one cause-effect path even when AND situations arise. For the case in Figure 6 two causes exist—‘Distributor not sealing’ AND ‘Water over distributor’

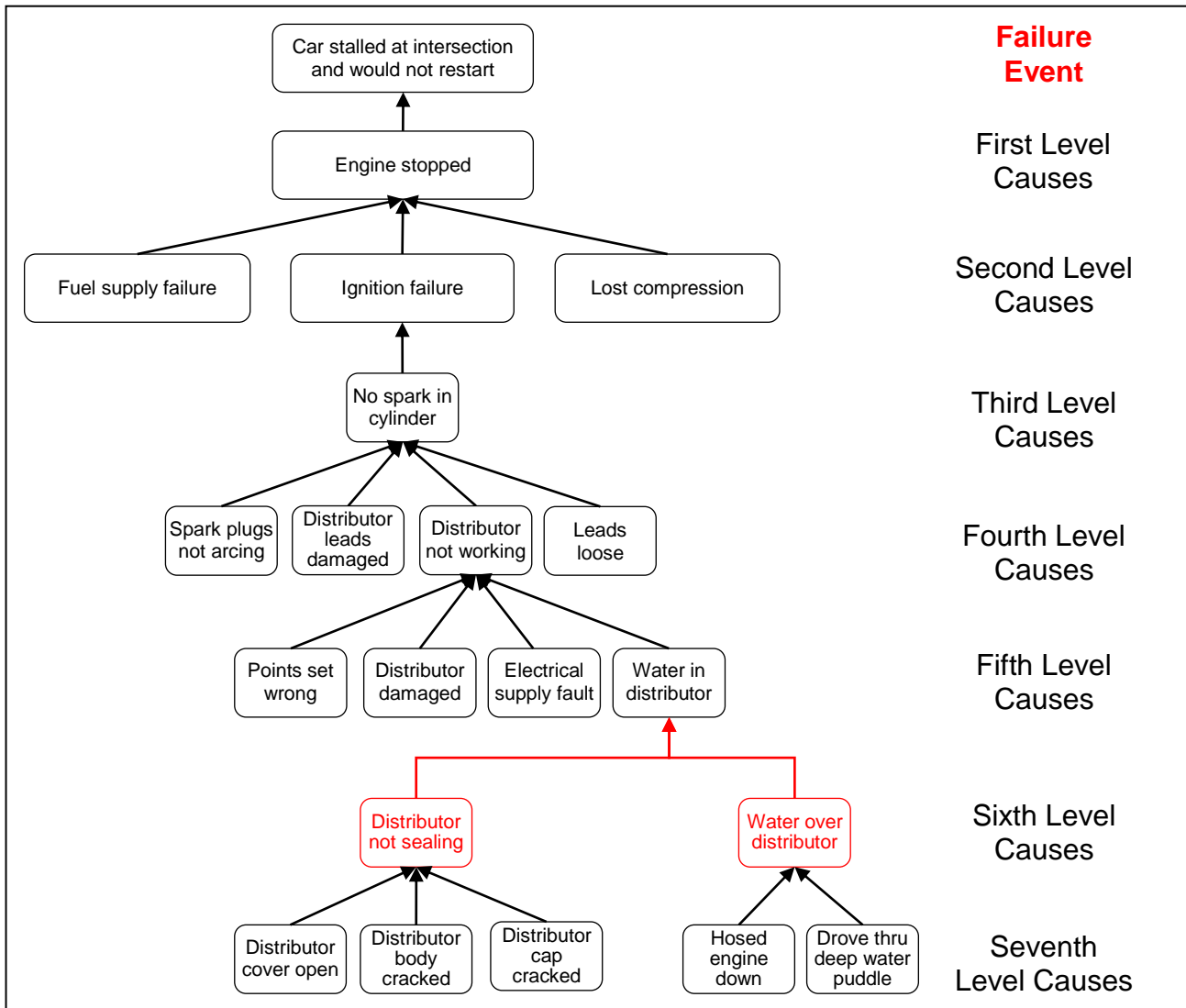


Figure 6 AND Gate in a Why Tree

You can never know if there is only a single cause for an effect until you first develop the whole sub-cause and sub-effect tree for the effect under consideration. Where there are two or more causes acting together to produce an effect each individual cause will need its own Why Tree to identify and prove all sub-causes and effects leading to the higher effect being investigated. People will claim in AND situations that because the higher effect requires two or more causes to arise, like a fire needs oxygen, fuel and ignition, you only need to remove one of the causes to stop the effect. This thus justifies using the Why Table alone since even if it only follows one cause-effect path any missed AND situations are still prevented from arising because a lower root cause is removed. The problem is your analysis is illogical, superficial, incomplete, and the proposed solution is unlikely to be effective in the long term when you only use a 5-Why Table. Having a Why Tree for each leg in AND scenarios is the correct practice to adopt. It helps you to make the best business decision because you find the most effective, least cost sub-cause and effect leg to prevent.

It is vital you always build a cause and effect tree of your failure incidents. Only a tree can show where events branched and if single or multiple causes had to be present to produce an effect. If you only use the Why Table without a Why Tree to direct you may not even suspect there is an AND situation. You are very likely to generate a seemingly sensible answer and write it down without realising an AND situation was present. It is only when the answer to a Why question in the Table cannot fully explain the occurrence of an event that you will wonder what is going on. If you are lucky you will become uncomfortable because the logic is clearly incorrect or incomplete. It is then vital to stop and build the full Why Tree to see if there is an AND situation. You then use a 5-Why Table for each branch to confirm the evidence proves your logic is right.

If you have an AND gate in your Why Tree each cause-effect path ought to be separated into its own Why Table (or on the one Why Table you give each cause-effect path its own set of rows and identify the rows, such as with colour coding or shading, to differentiate them from the other cause-effect paths). For the case in Figure 6 you could start two new Why Tables (or separate sets of table rows)—one for ‘Distributor not sealing’ and another for ‘Water over distributor’—to fully understand what happened to expose an unsealed electrical system to water.

**Going to the True Root of Failure—Identifying Latent Causes**

In Table 1 you saw a Why Table of a delivery failure caused by a storeman not getting to work on time. It turned out that he had lost all his money in a card game and had none to buy petrol to get to work. Because he did not turn up a delivery was missed and the company was penalised \$25,000 and lost years of future business. Though there are several possible answers listed in the Why Table to address the top problem caused by not having money, we have stopped short of asking the most important question of all—Why did he gamble all the money he had? This person had a low paying job, he had a family to support, he had debts to pay, yet he bet all his money in the game. If we were to do a Why Tree on this man’s poor betting decision it would look like that of Figure 7.

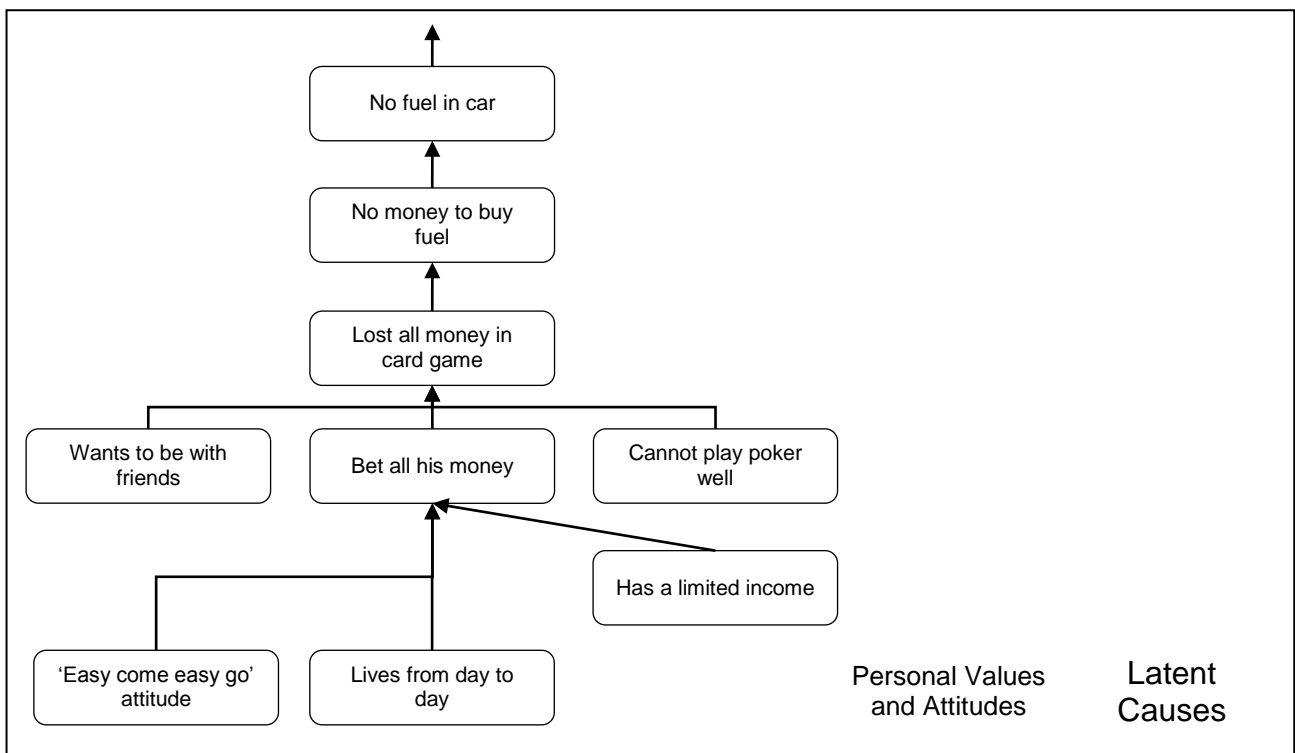


Figure 7 Why Tree of Late Delivery Latent Causes



We have not fixed the real root cause of the failure—this storeman’s gambling problem. The gambling is a latent cause. It remains there waiting to trigger more troubles in future. This company will have many problems with this storeman because his view of life is ‘easy-come-easy-go’ He is his own worst enemy and by default he is his employer’s worst enemy as well.

The values and beliefs of this storeman were what actually caused the failure event that cost his employer \$25,000 penalty and \$2M lost future business. If we did not know that the man was a problem gambler you could not prevent the root cause. In fact, if we did what was suggested in the Why Table, that he carry a credit card in case he runs out of money, we would put him at high risk of getting into serious gambling debt. His illness would make him max-out his credit card. Once we learn of the latent cause we are able to make a more effective choice that reduces the chance of a repeat problem (have him carry a mobile phone to ring someone to get him to work).

As the manager of this man you are in a dilemma. Clearly he is a huge risk. Should you dismiss him or put him in a lesser important job. Even in a lesser position this man’s attitudes and value will always expose the company to trouble. The latent causes are the most critical ones to find, but they are usually the hardest to deal with and often they are embarrassing for all involved.

## Using 5/7 Whys to Confirm Failure Path

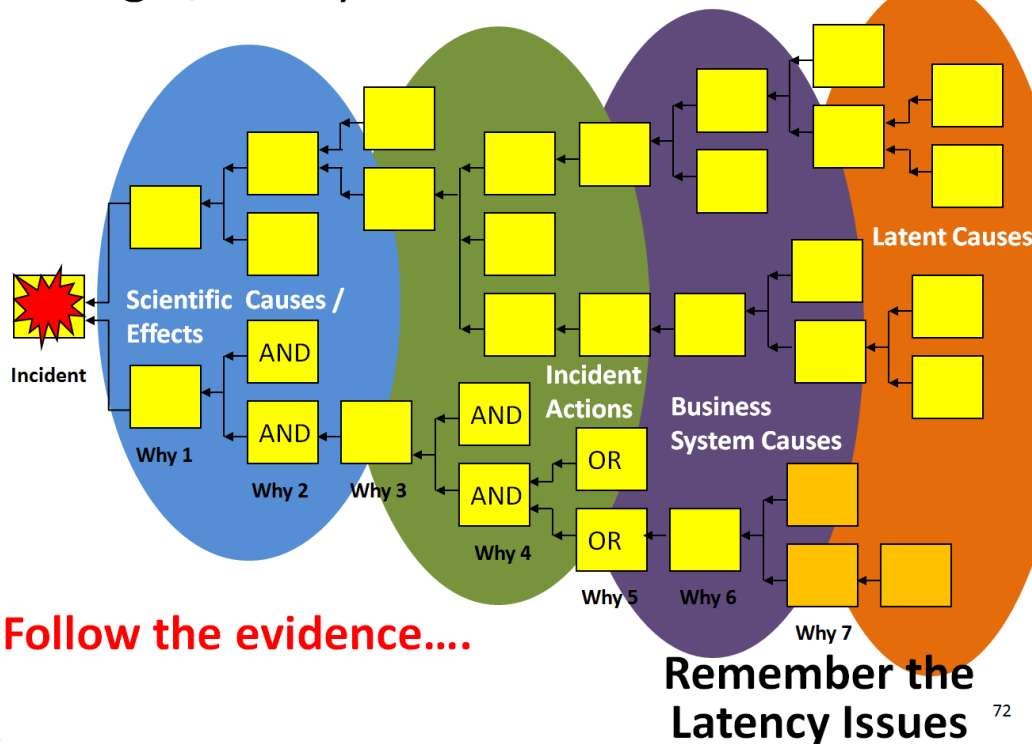


Figure 8 The Progression of Failure Incidents and Events

Until you know the latent causes that triggered a failure event, and you stop or prevent them, you have not addressed the real root cause. Our experience with failure events around the world and across many decades has highlighted the existence of a causal sequence of circumstances that exist when failures occur. Figure 8 shows how an incident can first be traced to its scientific Physics of Failure factors, going back further we can see situational events relating to the circumstances present at the time. Further back we can spot business process failures that allowed unwanted situations to arise. Finally we get into the region of latency where individual beliefs, values, lack of



vital knowledge and personal opinions breach business system protection. A failure event should be traced back to its latent factors.

## **Conclusion**

The 5-Why root cause analysis method is simple in concept but requires real evidence, sure logic and great discipline in its use if you want to find the true root cause of a failure event or problem. You can only complete a 5-Why Table to the true root cause if you first have the correct Why Tree for the occurrence. There are many incidents and events that can cause the top level failure and during the investigation you must find all cause and effect branches to the root cause(s). If you go the wrong direction you will fix the wrong thing and leave the true root causes behind. The missed causes will sit in your business awaiting the next opportunity to bring you more strife and trouble.

You must keep all the evidence when a failure happens. If you do not have real, honest evidence then stop the analysis and go find factual proof. It is pointless to go further since all you do will be speculation, opinion and guesswork. If you get the right root cause it will be entirely due to good luck—hardly acceptable and adequate for sound decision making. Make it a company policy—an unbreakable law—to always keep all the evidence safe. With complete, true evidence and facts you can uncover the whole story down to its real roots and cut them out.

My best regards to you,

Mike Sondalini

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