a test plan for analysis and data collection it starts all the way back home you get our specifications so our specifications whether it's an iteration of a machine we have today or whether it's a brand-new ground up as an engineering group we should sit down and we should look at those specifications match them up to our core competencies today and identify areas of risk that we may not have an established solution for in our system and our portfolio of knowledge or it's something that we're not satisfied with our current solution to this an example might be a ground drive system for a track machine we know how to do that we've done it, but our solutions today may not be adequate for what the new machine requires or it's we found in our points of the customer and house quality that's an area that if we improved our customers would value that so from that we'll develop a virtual test plan so we will be looking at if there were let's switch gears and think about reliability, we need enhanced reliability of our track system so we can do some bench testing and set up a plan to do you know what our bearing loads are what are our speeds and do that benchmark what we have today

and then and then test to that in a virtual environment it could just be loading it could be hand calculations it could be FAA all of that would get us to burn that risk down because ultimately we'll find those areas we've identified those areas of risk so reliability will always be a risk in a new design performance is a risk and then we'll break that down at the subsystem levels so we're worried about track reliability we're worried about cutterhead performance we're worried about operator interface let's say those are our three main risk areas so we're going to tailor that test plan to burn that risk down through the project and the earlier we can burn it down the better so our test plan may start with we're going to do very load calculations on our undercarriage and we'll verify that in physical environment after we build it we're going to do Fe a on our mainframes

before we ever build one and then we'll follow it up with stress coding and strain gauging and the SEC you know cycle testing in our lab environment, or it could be from an operator interface we are going to mockup three or four 51 different simulated operator stations bring fifteen or twenty people in and watch them operate this this virtual piece of equipment where do you put your hands what does that interface look like

so we can do that whether it's virtually or with very quick mock-ups we I've started to use the term Minimum Viable prototype which may just be an existing machine we talked about we're not happy with our technology today so we take an existing machine cut a couple parts off mold something in could be cardboard could be duct tape could be whatever and okay do we like this layout and we'll do that multiple iterations before we ever build a physical true prototype so we'll start burning that wrist down so that's kind of the basis of our plan and our entire plan should be about burning down those identifying risks the magic maybe is in how do you decide if you burned down the risk enough and you've probably never burned it down to zero but you need to get to a tolerable level that we all agree we're going to launch that product the risk assessment tool that we

use that gives us the best results from a logical robustness standpoint is DFMEA design failure mode effect analysis and the value of that is it really forces you to think of every possible conceivable way that this subsystem or component can fail and put out there well what would happen if it snapped in half what would happen if it yielded what would happen if this pin did this and so it lets you think through those eventualities before you build that that physical prototype once you have a physical prototype and it fails and becomes very expensive to fix and the lead time is longer and the more we can do before we ever build a prototype risk assessment and mitigation the better off we are in the faster we are to market the people would get involved

for DFMEA and that approval is certainly the core design team so that would be someone like me a senior

project and the design team that's on it but we would also get personnel from our service department our field test possibly our corporate test they do a lot of our lab testing they would absolutely be critical for that because they should be subject matter experts on I'm failure mode they've seen or they've thought about through their history of testing this sort of equipment will bring them all in the room and once we train them on that process and get the ball rolling the ideas really come of ok it can failed this way this way this way

this way it's all about getting as many people as you can to list as many of those failure options as you can and be able to contribute in that environment the biggest challenge with developing a DFMEA is quite honestly to trust the process because it's a very hard process to trust because you look at it and on a surface it's it seems kind of silly right we're just going to imagine how many ways we can fail this subsystem or component what would happen and you know 50% of them are never are possibly never going to happen but it's a little nuggets of and I never really thought about what would happen if this actually broke that that is really valuable and being able to trust that process and stick with the rigor of it is the biggest challenge when we try to implement something like a D FMEA or even how when we build our test plan and our risk assessment it's about the rigor of staying within the process of understanding the value of it and going all the way through because a lot of the times we want to use just a cookie cutter and it never fits quite right and we always miss the risk assessment because every project is unique in where the risks are and where the innovation opportunities are as well

I think my expectations for a new engineer and in a you know they're going to come in with a fresh set of eyes and sometimes the most dangerous thing is preconceived notions if I've been through six of these projects on this exact same machine I kind of I forget the risk that I saw on the very first project and so the value of a new set of eyes whether it's a new engineer whether it's a new test personnel or a new service manager even as they have none of those preconceived notions my expectation is not only do they have that fresh set of eyes but they're willing to speak up and articulate their concerns in a group of engineers with a lot more experience and personnel with a lot more field experience than they do even willing to speak up and say what about this and be willing to you know maybe be a little foolish sometimes and throw that simple question out there.