Citation

Love, P. and Teo, P. and Ackermann, F. and Smith, J. and Alexander, J. and Palaneeswaran, E. and Morrison, J. 2018. Reduce rework, improve safety: an empirical inquiry into the precursors to error in construction. Production Planning & Control. 29 (5): pp. 353-366. http://doi.org/10.1080/09537287.2018.1424961

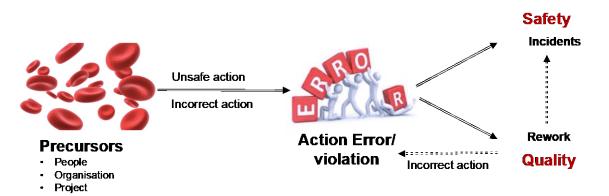


Figure 1 Conceptualisation of the causal chain for rework.

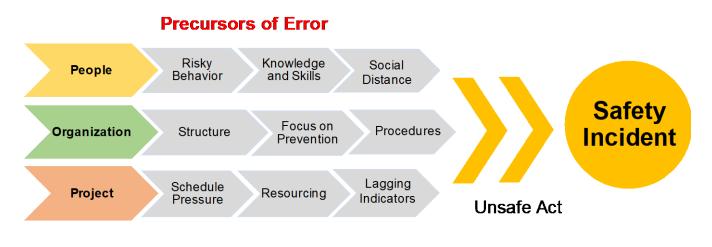


Figure 2. Precursors of error for safety incidents

Rework

Risky Behavior

Interviewee K: Most rework in my experience occurs due to risky behavior. Generally most NCRs happen because they (people) don't do what was planned. We have pre-start toobox talks but how much actually transferred, communicated to them is a big question. Even though may have been doing the job for 20 years but when the situation changes, a location is changed and environment is changed and there is pressure to get the work done, they [subcontractors] tale short-cut5.

Knowledge and Skills

Interviewee C: "With regard to concrete, workmanship issues are a problem. Not having adequate vibration, and being able to get the grout down into the blockwork forms; so that's a workmanship and understanding of the importance of core filing. In the sense of work, I guess workerrelated competency'.

Interviewee G: "I think in the last four projects I have been involved with, most of the time, the subcontractor is only interested in signing the contract, and they come on board, and they don't fully understand the full ramifications of what's required on the job. They simply don't have the experience, the company may have but its employers that they have put on our jobs don't – this is a key reason why we get rework. We often don't have enough supervisors to watch to them".

Interviewee J: If it's quality related, they'll [subcontradors] take a short-cut straight away. Even those on [a project S/C] and you'll a specification for a warehouse floor and instead of putting in things like, leveling the rails and all the rest, they used people used to building foot paths and didn't level the floor. Because they were holding up the pouring of the slab they did the leveling by hand instead and just wore the NCR - management didn't really care.



People

Social Distance

Interviewee E "Young guys on site don't really get access to the older guy's who have all the experiences. They can have an awful tot about the need to get it right and taking prote in their work. The older guy's have been around and know that going at the end of the day is all matters. Most of the older tradies are pretly safety savvy, but they also know the short-cuts, which is hard to manage". Safety

Risky Behavior

Interviewee F. "When you start investigating, when you start prodding, when you start getting people to open up it will always find its way back to the dolar. I wouldn't say people take short-cuts with intent or even deliberately, but we are always rushing so there is a higher frequency of incidents".

Interviewee G: At the piling rig where they were lowering the cage into the pile, aftet the concrete had been poured, and as it started to go off, they tried to remove the cage, and they tried to use a crane to do it. The chain holding the cage snapped — it could have been dangerous at that point. They were ushing to get it done, program first. From memory supervisors were sacked because of risky behaviour*

Interviewee H. We had a guy who fell through a penetration. He went outside and over the hand raits, so this was behaviour driven. Instead of staying within the confines, he jumped the hand rail and then hit the penetration and down he went. He took a short-crt...*

Knowledge and Skills

Interviewee D: "We subcontract out 99% of our work. We have an obligation to provide general training instruction to our subcontractors, particularly around our systems. The subcontractor needs to provide adequatetraining to its employees. But they dont"

Interviewee E: The subbies were rushing to get things done as we were behind program. Everyone was nushing, so they were cutting corners. PPE was not being worm, people not wearing helmets glasses. Most of the safety events were projectiles going to eyes, cut hands, and a couple of limbs. They had not been educated about PPE'.

Interviewee H "A young guy clipped on an aluminium top rail section on the side and he leant against that, and fell 1.8 metres onto his head. He was either unstalled, or dich't have the knowledge, the scafold had been incorrectly built. But, they had all the tickets to say they could do it, and had been trained in it before, but they obviously did it another way – we don't knowwhy?"

Figure 3. Examples of people 'precursors' to error

Rework

Organization

Schedule Pressure

Interviewee F. In terms of rail safety incidents, they traditionally occur with rework and rushing. In one project we had three or four deraiments in a space of two weeks and that was just because everyone was frantically rushing around to get scope out. Just minor stuff where machines would strike platforms because they ween't set properly weren't being supervised. We had breaches of rules because people weren't being supervised. Jobs simply don't have enoughtat in thermand supervisors are stretched".

Resourcing

Interviewee B. Under resourcing from a Q perspective. We have a combined role, which certainly isn't enough. So, if you have an SQE or HSEQ, you're nevergoing to get these. If you are an S manager then you are not responsible forit

Interviewee B: "Checks and balances that would typically take place on a daily and weekly basis by these Opractitioners marring around, the value was unseen. The value of quality was not acknowledged by senior leaders. There is a belief that anyone can do it?

Interviewee K. Most of the time the budget is severely cutto the bone. We are Tier 1 contractor, but we do work that can be done by a Tier 3 who use less resources. We tend to put fewerstaff on these jobs.

Managerial Commitment

Interviewee D: It comes back to culture and management commitment. If culture and the messaging around rework was like it was with safety, like, if rework goes up, then someone dies, we might turn the tide. I am not saying that we'll ever be able to provide a message like that, but if we treated it as seriously as we do other cultural angles, like environment and safety, I think you'll see a massive shift in business improvement'.

Interviewee A: "We don't understand the noot causes, and we don't have the right people in the organization really promoting this. Really stepping out and promoting the importance, prompting what've learnt. We need commitment from management to say "Hey, you guy's its important we find out exactly why things happen, and then we put a fix in place so it doesn't happen again"

Notions Losifold

Safety

Schedule Pressure

Interviewee A: From my perspective, we're not making margin, which has meant the organization has been cutting back on resources, which is causing more rework. Which affects the margin again. We are in a cycle and we need to come out of it by investing, reducing and increasing our profils. When we get rework we're confronted with schedule pressure which impacts our safety; it's a vicious that we need to break*

Resourcing

Interviewee G: If you say the word, safety it is a show stopper, management will listen. But what they have done is piled other areas into the safety, so it's getting less resource but they expectit to be given the same importance.

Interviewee H: "I'm always very critical about how we manage rectification works. It's not a matter of, go hell for teather and whalever it takes to get it done, it's a matter of....we can still do it as quick it's just got to be planned. But, no matter how well we plan, resourcing becomes an issue and so does cost, the potential for safety to be comprised increases when this unplanned work occurs. New risks emerge. We always under the pump so we'd lorget sometimes to do things –just the pressure of the job"

Interviewee I: 'If we've [the company] bits of work on, and this one [project] is finishing, and this one's started, they'll put minimal staff on projects that are starting. They move people when the project is finished to the new one rather than employing new staff. So at the start of projects we have poor resourcing and both quality and safety are affected, supervision is an issue'.

Lagging Indicators

Interviewee J: "All quality and safety teams are pushing their own agenda". No one wants a safety incident, and the problem with quality is that it affects your pocket. There is nothing that legislates anything to recover those costs. With safety you have something that is very tangole. You have and terms, lagging indicators used to indicate progress toward compliance with safety rules. But these indicators don't tell you how many people got hurt and how badly, but not how well our company is doing at preventing incidents and accidents. If we reduced rework maybe we could prevent incidents?"

Figure 4. Examples of organization 'precursors' to error

Rework

Strategic Disconnection

Interviewee A: We have established policies and procedures but the projects do their own thing. There is a disconnect between corporate vision and the projects we deliver. Some projects go really well, they have top people on them, others go bad. Why, well, project manager's a driven b deliver the margin and that's what counts. We need everyone b pull in the same direction and this isn't happening, particularly the reporting of NCRs².

Focus on Prevention

Interviewee A: "Behavior tends to travel around with supervisors and those site engineers and senior engineers and the project manager, and project directors. We've seen some benefits out of people putting up their hand and reporting early and fixing a small issue rather than the big issue that going to happen. Reporting sits at the project level, and culture in projects varies. There is no culture of saying don't report, but then again they don't say go ahead and report. They're [management] not encouraging the behavior. They just don't tak about it, the right behavior in the first place"

Interviewee B: "I think there's still a reluctance in many parts of the business, because unlike safety, it's easier to hide rework. When someone is injured there are different kinds of parameters at play. First of all, if you injure someone, there's a clear legal obligation to rotify, to take certain action, and that is very tangible, and obvious".

Interviewee C: Lessons learned lend to stay within the project, they don't tend to come out as global initiative. This sort of communication isn't shared within the organization. There have been attempts and there's a database out there, but there is no appetite to go and deve in and look back'

Managerial Commitment

Interviewee F: We were encouraged to report rework and safety incidents on the project I guessfor the purpose of continuous improvement, but we all knew nothing would ever get done about it, so there were some cultural issues on the project. There wasn't really any commitment to look at improving. I guess when you raise something and you try and fix it, you get a lot of resistance, you don't get support from the management side, so the thinking on the project was "why bother?" **Project**



Structure

Interviewee K: "Basically safety has been done by people who come from trades and non-engineering backgrounds whereas quality people come engineering backgrounds. Management say the safety is most important and they put quality under safety. Top management think that safety and quality are the same thing and the same as environment. Very few engineers become safety people. The company has bundled them all logether to save money as part of a re-structure! So they safety simportant but they have diluted it and quality".

Focus on Prevention

Interviewee J: "Look people just think "I will penalized", and if you are honest you may get terrorized and lose your job if people report something. To be honest with you, this is something everyone has in their mind, why should I tell you this its not my job. This is not my responsibility, it's sometody else's...Or, if I say something management will know and I will impact the project.

Interviewee K: "Reporting of safety incidents depends on the consequences. If its a minor thing, they wouldn't really want to actually"

Interviewee G: "People have been recording things the wrong way and not reporting everything that they are supposed to do. Details are lacking as they don't want to be asked tooo many questions".

Interview H: "... I mean losing your job is big — there was no counselling, I think they were walked off the job formot following procedures.

Interviewee L: "Subcontractors don't openly report incidents. If they can get way with it, they will, I guessthere is a fearfactor"

Procedures

Interviewee F: "It's all about safety. Safety this. Safety that. We can't do our job property because we've got all these safety rules we've got to do and I can't fi this and that doesn't happen or I run out of time, because I/ve spent all moming doing all these pre-starts and getting all my paperwork ready, and then I am rushing in the afternoon, and then I find I'mcutting corners because we can't finish the job on time'

Figure 5. Examples of project 'precursors' to error



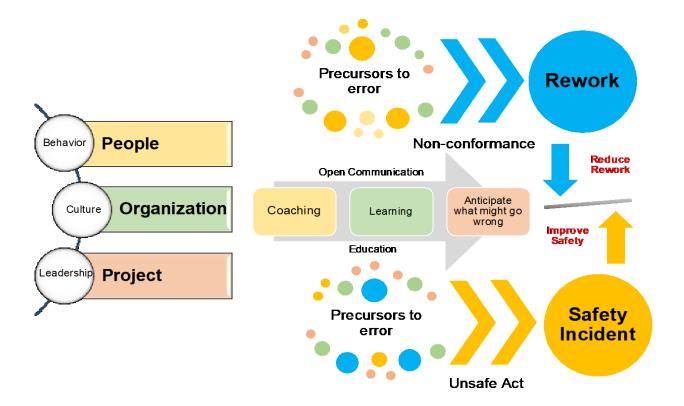


Figure 6. Mitigating precursors of error