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Learning from Breakdowns in the Last Planner System®

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Introduction

The Last Planner System® (LPS®) Process Benchmark 2020 initiative was launched to develop improvements in the Last Planner System®. Five improvement focus areas were selected, and task teams formed for each. The task of the team presented herein, was to extend the LPS to address how to learn from breakdowns in planning. Breakdowns are defined as situations where the planning system is not working which leads to an unplanned outcome. Some breakdowns result from failures in the planning system (e.g. failure to remove a constraint), while others result from a failure to improve the situation when a failure is identified. Planning systems aren't expected to be perfect, but it is expected that every opportunity to improve planning system performance is taken. Core to this premise of learning from breakdowns is the concept of psychological safety. Individuals must feel safe to surface and share breakdowns to address them and make improvements. This research also pinpointed the concept that learning from breakdowns should not be restricted to projects alone. Breakdowns occurring in the home office functions such as Human Resources, accounting, finance, etc. could also benefit from these concepts.

Our team chose to focus on six themes that surfaced through discussions with practitioners and planners in the construction community. The six themes included;

1. Psychological safety,
2. Organizational processes
3. Selection for the investigation of breakdowns,
4. Countermeasures,
5. Tracking success or failure of countermeasures and
6. Lessons learned.

Breakdowns, if unidentified or left unaddressed, can lead to significant delays and missed commitments. To evaluate the effect of these themes on learning from breakdowns, our team researched available literature and gathered information from companies that have processes in place to learn from breakdowns.

- Psychological Safety: A significant constraint to surfacing breakdowns is reluctance of employees to bring up things that aren't working. In a construction setting, workers don't openly admit failures or problems for fear of retribution or other negative impacts. Our research surfaced techniques and

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behaviors that foster a psychologically safe environment to surface breakdowns. A key component is to stop blaming people and focus on the process that created the breakdown.

- Organizational Processes: Organizational processes are critical to addressing breakdowns. Our team observed a lack of organizational processes such as clarity around roles & responsibilities, assessment of team member capacities and escalation of breakdowns to leadership as contributors to breakdowns. Clarifying organizational processes up front will help teams address breakdowns in an organized manner.
- Selection for the Investigation of Breakdowns: Not all planning breakdowns warrant a full-blown investigation. This research proposes a prioritization matrix to select breakdowns for further analysis. Key components of the prioritization matrix include; impact to the project (schedule, value to customer) and difficulty in tracking down the causes. This will give teams a basis to move forward to further investigate where breakdowns are happening and why. We recommend using A3 thinking to investigate the breakdown. Investigation techniques will draw from Root Cause Analysis tools such as; 5 Whys, Fishbone diagrams, Causal mapping, etc. Brief descriptions of these tools are included in later sections.
- Countermeasures: After the root causes are understood, developing countermeasures is the next critical step to getting things back on track. There are several tools such as Choosing by Advantages to select the right countermeasures.
- Tracking Success or Failure of Countermeasures: Tracking success or failure of countermeasures helps build team understanding of how to avoid making the same mistakes and provides data for capturing lessons learned. Tracking success or failure needs to be explicitly assigned to a team member.
- Lessons Learned: This paper suggests guidance on how to capture Lessons Learned. There are five key elements in capturing Lessons Learned:

1. What happened?
2. Why did it happen?
3. So What?
4. Now What?
5. What will we do differently?

Structure of the Paper

After this Introduction, this paper consists of:

- A review of the relevant literature, intended to identify gaps in knowledge (know-that and/or know-how)
- Interviews with subject matter experts
- What's New
- Conclusion and Recommendations for Future Research
- References

Literature Review

A paper by Harvard Professor Amy Edmondson (Edmondson, 1999) discusses building a psychologically safe workplace. She states that no one wants to look ignorant, incompetent, intrusive or negative, so a solution to this is focused around impression

management. Every time we focus on this, we rob ourselves of small moments of learning. Psychological safety is a belief that one will not be punished or humiliated for speaking up with ideas, questions, concerns, or mistakes. Dr. Edmondson offered that better teams also make mistakes but commit less harm because errors are intercepted and corrected beforehand. Poorer performing teams without psychological safety reveal fewer errors, thereby appearing to commit fewer mistakes. Having a climate of openness allows problems to surface and gives teams the ability to get to root causes. Psychological safety can be built by framing work as a learning problem, not an execution problem; acknowledge your own fallibility, and modelling curiosity (ask a lot of questions).

Introducing Lean thinking into projects appears to make them safer (Howell et al., 2017). Key learnings from this paper focused around worker safety, but psychological safety was deemed crucial for the engagement of learning behaviours in teams, which leads to better team performance in all dimensions: safety, efficiency, effectiveness, innovation, and flexibility. When projects live by the lean principle of Respect for People, they reduce the frequency with which construction workers are placed in hazardous situations, and the frequency with which they are harmed when they do find themselves in hazardous situations. Psychological safety is crucial for the engagement of learning behaviors in teams, which leads to better team performance. Learning behaviors reduce injuries and occupational illnesses by reducing the frequency and extent of differences between work situations as planned and those situations actually encountered during execution. Learning behaviors also reduce injuries and occupational illnesses by increasing work groups' abilities to 'catch' errors before they cause harm.

The activities of learning organizations are visible in pull planning, in speaking up when there is a possibility that a constraint cannot be removed in time for task execution, in foreman and crew putting the finishing touches on a plan for the day, and in crew members working together to figure out how to move forward with task execution safely, even if that involves stopping the line. All these situations are opportunities to learn from breakdowns.

A high level of psychological safety within the team is a significant predictor of creative team performance and is mediated by the sharing of two types of knowledge; information and know-how (Kessel et al. 2012). Teams are increasingly valued for their potential to demonstrate creative performance. However, developing creative ideas or recommending a modification to standard procedures involves uncertainty and inter-personal risk taking. Psychological safety 'alleviates concerns about others' reactions to actions that have the potential for embarrassment or threat'. Knowledge sharing is the foundation of mutual learning. The sample used in this study consists of healthcare teams generally working with a low profit motive but a strong sense of social responsibility. New knowledge can only be created when existing bases of knowledge are shared through interaction. Pushing team members to speak up and contribute their ideas during plan development, fostering communication, and promoting team learning by urging team members to discuss errors, seek information, and mutually reflect on alternative viewpoints supports a safe environment. Knowledge sharing needs to be an interactive communication process between team members who rely on each other to accomplish common goals. Through the successful exchange of knowledge, teams may develop their knowledge base and combine this knowledge to develop new solutions. Different types of knowledge include; explicit knowledge - contents are easily codified, tacit knowledge - remains implicit and is difficult to express in propositional form. Information is easy to articulate but know-how is difficult to codify. Information describes a set of representations about objects, events and situations, and know-how describes practices and processes and is poorly represented by descriptions. As a result, weak ties may lead

to greater creativity as a result of the fresh knowledge that new participants bring to the team. Results suggest that a psychologically safe team climate lowers the hurdle of involvement in new and risky behaviors such as sharing ambiguous knowledge and showing creative performance. Exchange of knowledge is essential for the generation of new solutions.

Key findings outlined in a paper on psychological safety (Silla and Gamero, 2018) include:

- Psychological safety climate was negatively associated with time pressure
- Psychological safety climate was positively associated with drivers' general health and negatively with burnout.
- Time pressure is negatively related to drivers' general health and positively with burnout.
- The relationship between organizational tenure and general health turned out to be nonsignificant. These findings suggest that, when simultaneously analyzed, drivers' age becomes a stronger predictor of general health than organizational tenure.
- safety climate will influence the meaning and the salience of time pressure by emphasizing the value of safety and, thus, establishing manageable levels of time pressure.
- Safety climate would set expectations of low time pressure at work because it could be counterproductive for safety.
- Supports the job demands hypothesis and the role of time pressure as an energy-depleting demand rather than as a stimulating demand.
- Findings suggest that intervention programs that promote safety climate should be encouraged in an effort to decrease time pressure and, in turn, contribute to professional drivers' wellbeing.
- Organizations may emphasize the value of safety against other competing organizational goals, such as production (e.g., to reach the destination at a given time), through communication programs, training, personnel recruitment, selection, and promotion systems.

Interviews with Subject Matter Experts about Lessons Learned

1. The Boldt Company, The Reflection and Retrospective Process; LCI Presentation, March 2019, Dave Hagan:
   - Reflection is intended to capture learning and opportunities for continuous improvement.
   - Reflection is the intentional attempt to synthesize, abstract, and articulate the key lessons taught by experience.
   - Methodologies for reflection:
     - Three Step Reflection Process: What? -> Now What? -> So What?
     - Keep, Stop, Start
     - 5 Why's
2. Haley & Aldrich Lessons Learned Procedure Summary; June 2019, Bruce Wilkinson
   - Defines Lessons Learned Process as a "process that allows the organization to learn from our positive and negative work experiences and incorporate improvements based on what we have learned."

- Emphasizes on the "spirit of continual improvement without undue focus on positive vs negative aspects of a particular lesson."
- End goal: how to do things better, quicker and more efficiently.
- Lessons Learned Procedure: Any employee submits any lesson learned experience for consideration by the Quality Manager (QM). QM reviews and then shares it with the company so that others learn or benefit from the experience.
- Fundamental questions asked:
  - What happened?
  - Why did it happen?
  - What did we learn from this experience?
  - If we had it to do over again what would we do differently?

3. Southland Lessons Learned Procedure Summary; March 2019, Henry Nutt III
   - Lessons Learned Procedure: PM gets feedback from each department, then meets with appropriate departments to address feedback globally and identify areas of improvement.
   - They meet with a Continuous Improvement Committee that shares issues/solutions, makes improvement requests, and tracks progress to hold parties accountable until things are complete.
   - When reflecting on lessons learned they try to create an attitude of doing what's right for the project, and a "safe feeling" environment that lets employees share new thoughts and ideas.

Similarities:

- Create a psychologically safe environment for people to safely express their thoughts.
- Intention to create culture of continuous improvement.
- For a given situation, questions are asked to help get to the root-cause.
- There is an overseeing person/body that reviews lessons learned and makes sure they are shared across the company.

Differences:

- Haley & Aldrich characterizes lessons learned as opportunities on a local level or wider scale and has different procedures to follow for each.
- Haley & Aldrich makes use of a Quality Manager to follow through with lessons learned, while Southland makes use of a Project Manager.

Learning from Breakdowns – What's New?

Psychological Safety

Creating an environment of psychological safety has been shown to be a significant predictor of creative team performance. When teams feel safe to share, problems are more readily surfaced and the potential to learn from our breakdowns is enhanced. Without psychological safety, the entire system is subject to manipulation by those who are afraid to surface the real problems. Unfortunately, psychological safety is a learned behaviour that takes time and discipline amongst teams to develop. Therefore, our team did not come up with a specific tool to apply to creating psychological safety, but rather a

list of behaviours to encourage teams to engage in. Behaviours that appear to support psychological safety include:

- Showing respect to each other
- Encouraging team members to speak up during plan development
- Mutually reflect on alternative viewpoints
- Don't punish or humiliate team members for speaking up
- Framework challenges as learning problems, not execution problems
- Be hard on the processes, not on the people
- Acknowledge your own fallibility, and
- Modelling curiosity (ask lots of questions).

Organizational Processes

Roles & Responsibilities - As outlined earlier, our team observed that most teams suffer from a poor understanding of roles and responsibilities, essentially, who does what or who is responsible for what. Teams are encouraged to clarify roles and responsibilities early in the life of the project and make them visible to the team.

Escalation - An important aspect of addressing breakdowns is having a set escalation process. Our team observed that breakdowns often linger if there is no clear path to integrating appropriate decision makers in the process. Similar to the lack of roles and responsibilities, a lack of an effective escalation process can hinder the team's performance. Suggested guidance on escalation is provided below.

What to escalate*?*

- Breakdowns that can't be resolved at the Last Planner level.
- Cross-Company issues
- Issues that impact the entire project

How to escalate?

In the event that Last Planners can't solve a breakdown or project issue, the following individuals will be engaged (in the order shown) to help resolve the issue/conflict:

1. Superintendent
2. Project Manager
3. Project Executive
4. Owner

Selection for the Investigation of Breakdowns

Impact-Difficulty Analysis – An Impact-Difficulty Analysis is a prioritization tool to help teams select appropriate breakdowns for investigation. Because breakdowns are so frequent on construction projects, it is very difficult, and sometimes simply not possible, to investigate every one of them. Once we've reduced the number of breakdowns, it will be possible to investigate each and every breakdown in an effort to accelerate learning. The Impact-Difficulty Analysis can help you decide where to use limited capacity, and also can help team members develop an unbiased view of the breakdowns instead of focusing on "the squeaky wheel". It is a simple, visual way of representing the needs and is a quick way to help teams make decisions. An example matrix is provided below.

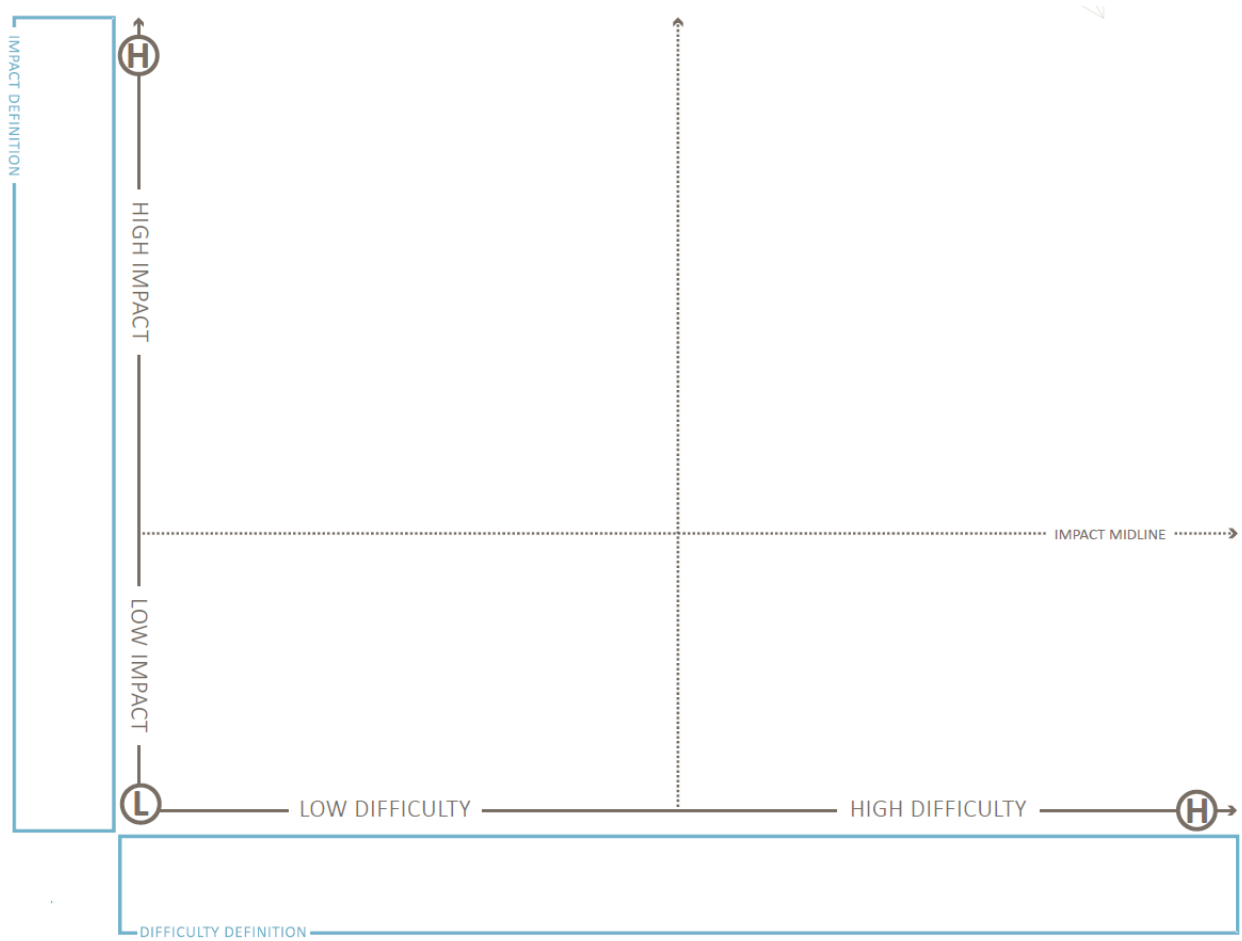

Figure 1. Sample Impact-Difficulty Analysis Matrix (Courtesy of Haley & Aldrich, Inc.)

Root Cause(s) Analysis – Once breakdowns have been identified for investigation, Root cause(s) analysis can be applied to identify, explore, and display possible causes of a specific breakdown. It helps drive teams to root causes to avoid fixing something that doesn't have the desired outcome. Often times, teams stop at symptoms of the problem and fail to get to the real root causes(s).

Two Lean tools that can be used to analyse root causes include:

- 5-Whys – A method of inquiry that deepens understanding.
- Ishikawa (fishbone) – Helps a team identify, explore and arrange groups of causes in increasing detail.

5-Whys: A Lean Tool that helps you:

- Push your thinking about a potential cause down to the root level in a quick and focused way.
- Question the first apparent cause (which may not be the root cause). Help separate SYMPTOMS from CAUSES
- Think about root causes by asking "why" 5 times (in other words "Why is this happening?" when a problem has been identified).
- Avoid being satisfied with countermeasures that won't fix the problem in the long run.

Below are 4 steps on how to use the tool:

1. Write your problem statement.
2. Ask "Why did that problem occur?"

3. Write down your response.
4. Ask "Why" four more times until you feel that you have determined the root cause(s) of the problem.

Below is an example of a form that can be used to facilitate a 5-Why exercise.

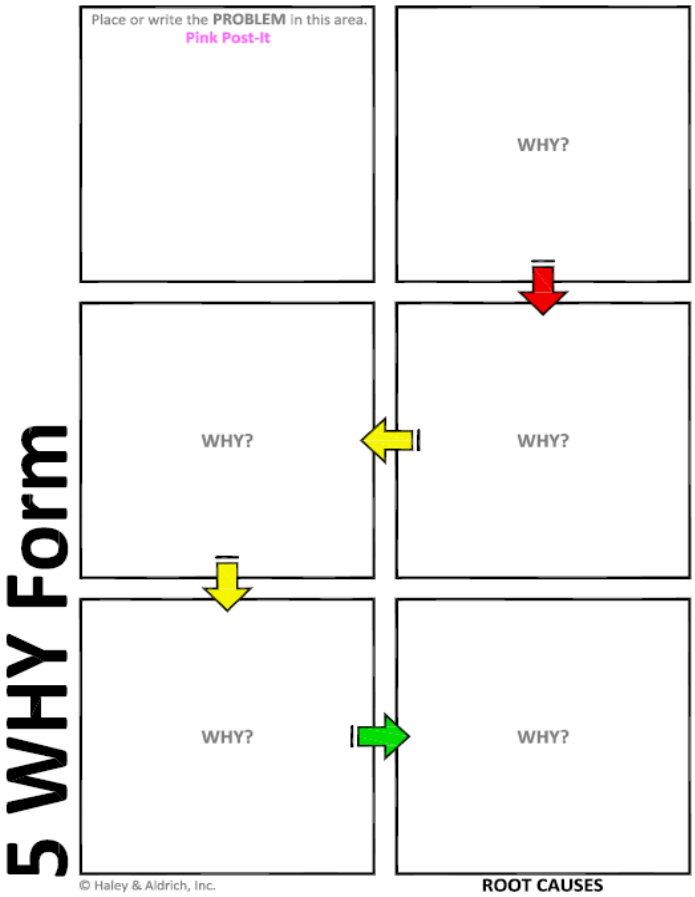

Figure 2. 5-Why Form (Courtesy of Haley & Aldrich, Inc.)

Ishikawa (fishbone)

A graphic display with increasing detail of all possible causes of a problem or desired effect.

Below are 4 steps to construct a fishbone diagram:

1. Identify the problem or the effect you want to achieve
2. Define the categories
   - 6M - Manpower, Methods, Materials, Machinery, Measurement, Management
   - 5P - Policies, Procedures, Process, Plant/equipment, People)
3. Brainstorm the causes
4. Construct the diagram

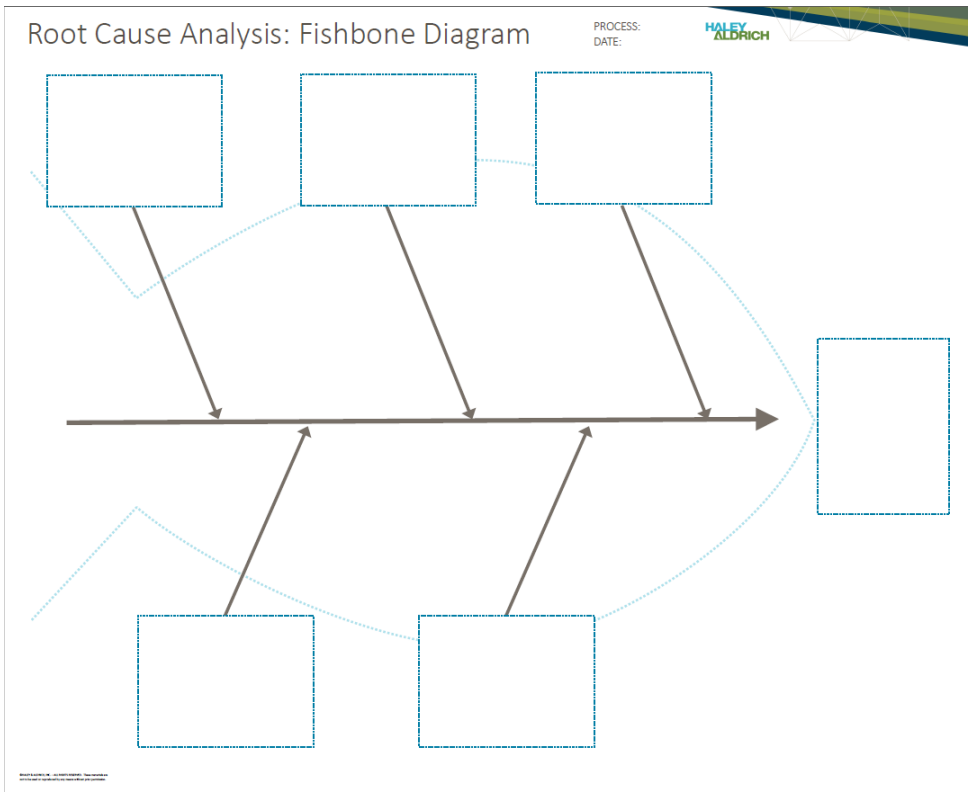

Figure 3. Fishbone Diagram (Courtesy of Haley & Aldrich, Inc.)

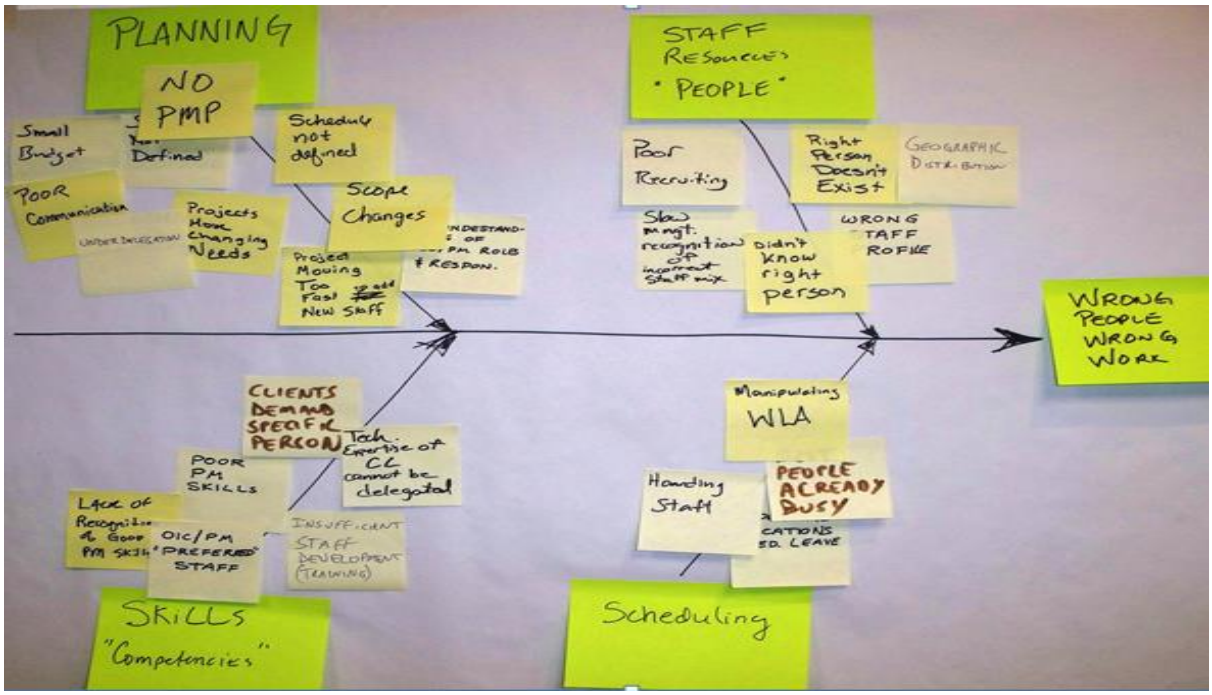

Figure 4. Example Fishbone (Courtesy of Haley & Aldrich, Inc.)

The strength of the Fishbone tool stems from being a "group process". You need to have the right people present, get everyone involved, allow conflicts - work with the group to resolve them, focus on the issue/problem - not on the people, and allow sufficient time to surface the issues.

A3 Thinking to Solve Breakdowns and Explore Countermeasures

The A3 thinking process should be used for problem solving, engaging people, planning, driving improvements, and communicating countermeasures. It's as flexible as Plan-Do-Check-Adjust (PDCA). The A3 process can help teams solve problems and identify countermeasures.

A3 Thinking can help teams address problems and opportunities by equipping them with:

- A quick, standardized and effective way to address and communicate our approach to problems or opportunities
- A method to generate ownership and get stakeholders aligned
- A way to apply the things we've already learned
- A way to pick the most important thing(s) to work on

A3 Thinking also allows teams to:

- See who is going to lead and work on the problem or opportunity
- Have a way to pace things
- See what results we're seeking and where we stand

Below are 7 A3 problem solving process steps:

1. **Background**: what are you talking about and why? What is the purpose, business reason for choosing this issue, specific performance measures needed to be improved and strategic, operational, historical or organizational context of this situation?
2. **Current Conditions**: where do things stand now? What is the problem, what is happening versus what you want or need to happen, what facts or data indicate there is a problem, what specific conditions indicate there is a problem, can you break the problem into smaller pieces?
3. **Goals**: what specific outcome is required? Show visually how much.
4. **Root Cause Analysis**: Why does the problem or need exist? What do the specifics of the issues in work processes (location, patterns, trends, factors) indicate about why the performance gap or need exists? What conditions of occurrences are preventing you from achieving the goals? Why do they exist? What is (are) their cause(s)? Use the simplest problem-analysis tool that will suffice to show cause-and-effect down to the root.
5. **Recommendations**: what do you propose and why? What are the options for addressing the gaps and improving performance in the current situation? How do they compare in effectiveness, feasibility, and potential disruption? What are their relative costs and benefits? Which do you recommend and why? Show how your proposed actions will address the specific causes of the gaps or constraints you identified in your analysis. The link should be clear and explicit!
6. **Plan**: how will you implement your recommendations? What will be the main actions and outcomes in the implementation process and in what sequence? What support and resources will be required? Who will be responsible for what, when, and how much? When will progress be reviewed and by whom?
7. **Follow-up**: how will you ensure ongoing Plan, Do, Check and Adjust (PDCA)? How and when will you know if plans have been followed and the actions have had the impact planned and needed? How will you know if you meet your targets? How will you know if you reduced the gap in performance? What related issues or unintended consequences do you anticipate? What processes will you use to enable, assure, and sustain success? How will you share learning with others?

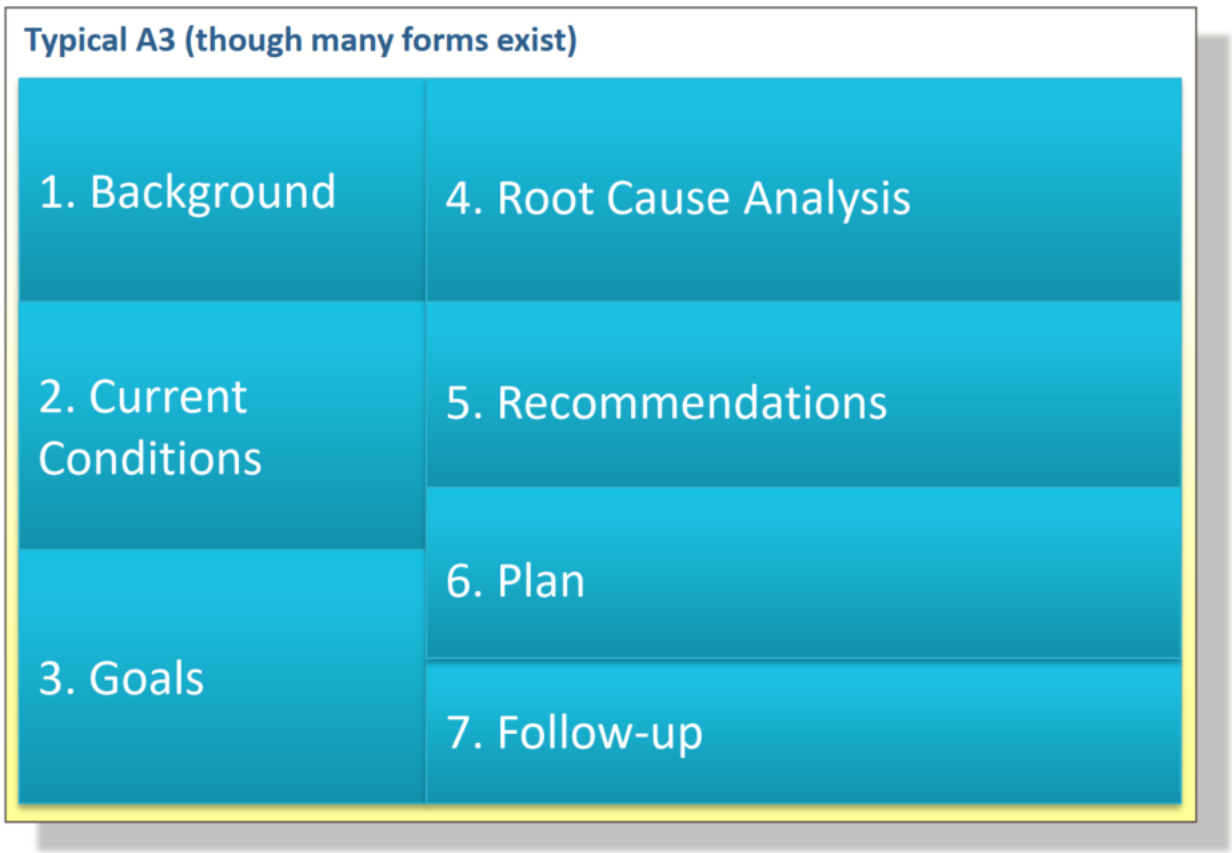

Figure 5. Generalized A3 Form

The A3 form arises from a collaborative process and includes needed information to make decisions on approaches or problems, to communicate the major points, diagnosis, implementation plans and to check and adjust.

Lessons Learned Standard Work

The objective of the Lessons Learned (LL) standard process is to allow the organization to LEARN from positive and negative experiences and incorporate improvements based on what is learned.

The LL process should be conducted in the spirit of continual improvement, without undue focus on positive vs. negative aspects of a particular lesson. The end goal is organizational recognition and communication of how we can do things better, quicker and more efficiently. In the LL Process we ask ourselves these five fundamental questions:

1. **What happened** – what did you hear, see, feel, learn?
2. **Why did it happen** – explore root causes using tools such as 5 whys, Fishbone diagrams etc.?
3. **So What** – why does what you learned matter?
4. **Now what should we do** – what actions are we going to take, who, when, etc.?
5. **What will we do differently** – keep those things that are going well, stop doing the things that don't contribute to value, start doing new things that benefit the project or organization even if they make you anxious or scared (experiment)?

How do I recognize a Lessons Learned opportunity?

LL opportunities may arise at any level on the project and may include events that impact site operations on a wider scale. As a result, these justify attention by site

leadership in order to get a better understanding about what changes in work methods would benefit the project.

Some positive AND negative examples of lessons learned could include:

- Example A: The application of new, innovative or exemplary approaches that resulted in above average or superb results. This experience warrants sharing with others so they can learn and emulate this behavior.
- Example B: The application of an existing process led to the discovery of likely pitfalls or difficulties that in sharing amongst the team will help others avoid having the same experience. Organizations should create an increasing library of techniques for avoiding pitfalls and mistakes in their day-to-day activities in order to make work easier or less problematic.
- Example C: The unfortunate omission, mistake or error that requires remedial activity to recover from a below par situation. This may be because, if not addressed, the event has the potential to erode the quality and/or functionality of the team's performance.

How does the process work?

The process starts with identification of the LL by any team member. Team members are empowered to bring the lesson to the attention of project leadership who will review the LL submittal, and if needed, talk with the submitter, to determine how best to proceed. Leadership may determine either that:

- Local team communication is sufficient;
- More review is warranted; or
- Site-wide communication is warranted.

If leadership decides that broader sharing of the LL is justified, then a designated team shall gather more background information. Leadership may discuss the LL submission with the submitter and other impacted parties to clarify the actual nature, description and characterization of the event and its fit with project requirements and/or organization policies. If it is determined that the LL could impact site operations or is an invaluable lesson that should be widely shared, a formal Lessons Learned Session should be scheduled and use of an outside facilitator should be considered.

Conclusion

In the Introduction to this research report, the following gaps were identified that, if addressed, could help teams learn from breakdowns where the planning system is not working as intended, which leads to unplanned outcomes. Some breakdowns result from failures in the planning system (e.g. failure to remove a constraint), while others result from a failure to improve the situation when a failure is identified. Planning systems aren't expected to be perfect, but it is expected that every opportunity to improve the functioning of the system is taken. Being perfect planners may not be possible, but it is possible to strive for and approach never having the same breakdown twice. Core to this premise of learning from breakdowns is the concept of psychological safety. Individuals must feel safe to surface and share breakdowns to address them and make improvements.

The following gaps were discussed in this research report: 1) Psychological Safety, 2) Lack of organizational processes (roles & responsibilities, capabilities, escalation, etc.), 3) Selection for the investigation of breakdowns (Root Cause(s), A3 thinking), 4) Countermeasures, 5) Tracking Success or Failure of Countermeasures, and 6) Lessons Learned. These gaps formed the basis for our research and investigations.

We offer a number of new ideas to integrate into the Last Planner System that are intended to help teams learn from breakdowns. A critical theme that emerged during our research was psychological safety. As discussed above, we didn't identify a specific tool to create psychological safety but did identify behaviors and different ways of thinking that can help teams create safer environments to share challenges and address breakdowns. Another key learning was the power of capturing and communicating lessons learned across the team and project as a whole. Lessons can be both positive and negative. Both represent an opportunity to learn and improve from past actions.

Limitations of the Research

Design science research requires validation that the artifacts produced are fit for purpose. That can be provided over a range, from having expert practitioners agree to try using the artifacts, to the trials having been carried out successfully. The validation of our proposed process for embedding options in schedules sits somewhere between these two extremes, and experimentation by practitioners is needed.

Recommendations for Future Research

Psychological safety is an important aspect of learning from breakdowns. The volume of research is quickly growing around this topic and this presents an opportunity to draw from emerging research to enhance the findings of this effort.

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