Behavioural Strategies for Improving Systems, Conditions and Behaviours

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The subject matter of identifying and mitigating root causes when the unfortunate happens is not a new concept or topic. In fact, one can argue that it is one of the fundamental practices in the safety world. That being said, most practitioners have faced the dreaded "finger pointing" that occurs when identifying the causal factors of an incident – namely blaming the employees. True, there are several examples where after exhausted efforts, the only causal factor lies with the responsibility of the employee. That being said, the authors of this paper would argue that is the rare event.

In incident investigations, a true root cause should be considered to be a failing of a management system – simply defined as a process or lack thereof that puts an individual to be placed in an unsafe situation. Root causes of behavioral factors of any incident can be linked to a failure of a safety system or leadership behaviors. This has been highlighted in the literature for many decades now however in practice safety professionals are constantly faced with those who want to point the finger at the employee. This calls for a specific tool or set of tools that can help diagnose behavioral factors.

The Performance Diagnostic Checklist (PDC) has been researched in the Behavioural Science literature and has merit in its application to incident investigations (Austin, 2000). The purpose of the checklist is to determine what influences undesired behaviour and how to modify the behaviour to a more desirable state. At FMC, the diagnostic tool has been used to focus on specific unsafe behaviours from unfortunate events. The tool has proved useful in two respects: 1) identifying systemic gaps that can be easily closed, and 2) identifying leadership behaviours that can be modified versus focusing on the employee's behaviour. This has made some significant cultural changes at FMC, and this paper looks to present the methodology and results from the use of the PDC.

Keywords: Root Cause Analysis, Behavior, Checklist, Culture

Background

In the area of Behavioral Science, research has identified techniques to truly understand what is at the root of the undesired behavior. Most ccommonly referred to as a functional assessment of behaviour (Horner, 1994), the methodology employs principles derived from the natural science of applied behaviour analysis to determine the "reason," purpose or motivation for a behaviour. Although functional assessment methodologies originate and have been used with much success in clinical areas of behaviour analysis (Derby et al., 1992; Iwata et al., 1994), the same is true in an organizational context. Mager & Pipe (1970) used flowcharting to determine whether a performance problem was a training problem or a consequence problem. Brown (1982) included the balance of consequences in his book to understanding those variables as a function of behavior. And in 1982, Daniels & Rosen modified Brown's work into the "PIC/NIC" analysis which has now one of the most widely used methodologies in the literature (Daniels, A. C., and Daniels, J. E., 2004).

Generally speaking, there are three types of functional assessments used: Informant, Descriptive, and Experimental Analyses. The Informant based functional assessments focuses on the use of interviews, questionnaires, rating scales or some other "indirect" (verbal) method. These methods are subjective, and a bit suspect as are all verbal reports of the behavior of interest. The Descriptive Functional Assessments take the form of direct observation of the behavior and are generally considered to be more reliable than informant. Experimental analyses (Pampino, Wilder, & Binder, 2005) are the systematic manipulation of specific antecedents and consequences that may affect the target behavior. This is the most reliable, but often difficult to execute in organizational settings. One of the most popular functional assessment procedures used in the field of Organizational Behaviour Management (a sub-field of Applied Behavior Analysis), is the Performance Diagnostic Checklist (PDC).

The PDC has been researched in the Behavioral Science literature, designed to identify areas in need of improvement or intervention within an organization given a specific undesired behavior. The four areas of the organization that are examined with the PDC are Antecedents, Equipment and Processes, Knowledge and Skills, and Consequences. Austin (2000) designed the PDC by interviewing professionals working as management consultants, as well as researching relevant research and publication in the area of causal analysis. These interviews consisted of presenting the consultants with a scenario consisting of an organizational problem, asking them to "think aloud" when trying to assess the problem, and then recording the most common questions asked by the consultants. Since its inception, studies have examined its effectiveness in various settings (Rodriguez et al., 2005), all showing positive results of the tools utility.

As mentioned before, the subject matter of root cause analysis is not new in the safety context. The subject matter most closely related to subject of Functional Assessments is Human Factors. Human Factors literature highlights the use of "Performance Influencing Factors (PIFs)." Guidance on PIFs help to determine the likelihood of error or effective human performance. It should be noted that PIFs are not automatically associated with human error. When all the PIFs relevant to a particular situation are optimal then performance will also be optimal and error likelihood will be minimized. The same is true for the four areas in the PDC. The application of PIFs as part of incident investigation is noted in Guidelines for Preventing Human Error. As noted, "Any investigation which seeks to establish the underlying causes of minor or major incidents will benefit from a systematic framework for evaluating the factors which can contribute to the human contribution to such incidents" (p 105).

The origin of the PDC did not pertain specifically to Safety, thus the need to introduce safety specific items was needed and the author utilized the classification structure for PIFs as input. Why modify the tool versus simply utilizing the PIFs and Human Factors Analysis tool? In short, the author was looking to engage employees in using a simple approach to incident investigation for both process safety and occupational safety, based on proven methodologies. Although the information obtained from using the PDC and Human factors analyses are subjective in nature, both have proven valuable when attempting to design interventions to improve performance. Hence fourth, the integrated tool will be referred to as the Behavioral Diagnostic Checklist (BDC, see Appendix A).

FMC's use of the Diagnostic Checklist

The BDC has been utilized to focus on specific unsafe behaviors from unfortunate events. Poor Ergonomics, Being in the Line of Fire, use of improper tools, and not following procedures are just a few of the unsafe behaviors that correspond with the vast majority of injuries and incidents we have seen over the last few years. In using the BDC we have seen two positive results: 1) identifying systemic gaps that can be easily closed and 2) identifying systems and leadership behaviors that can modified versus focusing on the employees behavior. This has made some significant cultural changes at FMC according to employee's accounts. A Case example is provided to illustrate the use of the BDC, results from its utility, and narrative of the results compared to what could have resulted without its use.

Case Example: fire on the catwalk

On October 22, 2012, an employee was completing a routine task performed multiple times a minute. Performed 3 times per 20 minute interval, highly trained employees work to perform a procedure of casting metal ingots from Lithium Metal. On this day, while "dipping" in one of the cells, the employee poured metal in a trap for the casting as per the procedure. While returning the ladle to the cell to gather additional metal, the ladle hit the front of the cell and turned in the employees hand causing it to spill on the front of the cell and the catwalk causing a fire on both the cell front and the catwalk. The metal also got on the employees coat (a specialty made coat which prevented the employee from getting burned). The employee followed the emergency procedure of pouring chloride on top of the fires to put them both out. This unfortunate event could have been worse. The specialty PPE, the employee's proper reaction to the fire and the engineering controls that exist all prevented this from being a worse incident. That said, the potential risk caused this incident to be investigated.

A typical in incident investigations, the investigation team illustrated the event in the form of a why-tree. As seen here in diagram 1, the why tree resulted in a behavioural factor of the employees pace of executing the task. Experienced employees and supervisors consistently discuss the focus on one's pace in performing this task. An optimal pace has been identified and is the subject of the intense training these employees go through. In this incident, the subject of the employees pace being too fast was identified as a cause of the incident.

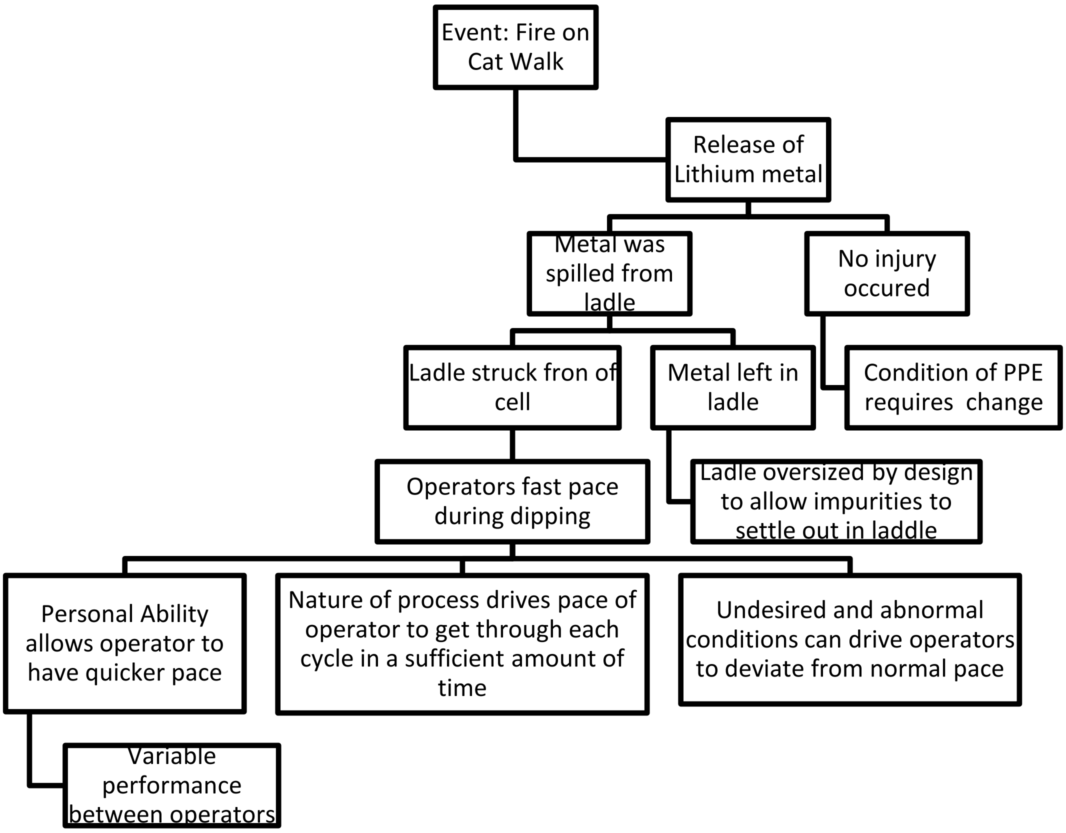

Diagram 1: Why-tree from Fire on Catwalk incident

The Behavioural factor of pace became a subject matter of great interest. As it is a specific training topic for this task, and it is a general focus area for safety, the team wanted to explore how to resolve this challenge of variability of pace between employees. The BDC procedure was used, interviewing the lead investigator who also happens to be the supervisor of the employees who perform this task. The interview was conducted with the author of this paper. The assessment took 90 minutes, working through each of the questions on the checklist, and reviewing any documentation that was associated with a "yes" response as a validation check.

Using the four categories of the BDC, the results of the assessment highlighted the following gaps:

Antecedents and Information: a lack of job aides available and visible that illustrates the desired behaviour and/or task steps

Equipment and Processes: the equipment itself equipment is not considered to be up to date or "best in class" against industry norms from a safety standpoint. Also, there is a lack of a formal evaluation such as a Risk Assessment or Job Safety Analysis in the last 5 years by an EHS professional.

Knowledge and Skills: no gaps were identified in this category. As mentioned before, employees who perform this task are highly trained, and regular training is conducted through the annual calendar.

Consequences/Reinforcement: 3 gaps were identified in this category. First, the supervisor shared that in a regular day to day operation, employee may not be able to stay focused on the task as multiple distractions can arise. Second, the conditions do not encourage the employees to maintain high rates or long durations to performing the task. This is actually not unusual for the task, as the employees can only work 20 minutes at a time under the specialized suits. Third, there is no observation or routine "check" required to ensure procedures are followed for safety or quality. This last point was of particular interest by the supervisor and investigation team as maintaining regular check points and observations could provide support for the employees to maintain consistent pace.

As explained by the author, not all "no" responses require action. The "no's" should drive discussion on whether an action should be taken based on its potential impact to improve the safety of the employees and its practicality. As a result, two actions were taken that otherwise were not identified during the original investigation. First, a formal Risk Assessment was completed which identified engineering control measures that were needed to ensure the employees safety. Second, The use of visual job aides and routine observations on pace was initiated by the supervisor and staff. Since this incident, the BDC was used for another five unfortunate events, all with similar findings of the utility of the BDC.

Culture Changing

Safety Culture is a term that has several meanings. The authors of this paper found the following as notable ones worth mentioning:

- The Safety Culture Policy Statement defines nuclear safety culture as the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment. United States Nuclear Regulatory Commission (2011)
- Safety culture is the ways in which safety is managed in the workplace, and often reflects "the attitudes, beliefs, perceptions and values that employees share in relation to safety" (Cox and Cox, 1991).
- "The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management" (HSC, 1993a, p. 23).

In addition to these definitions, the authors found two other source materials worth noting on the topic of Safety Culture. The United States Department of Labor Occupational Safety and Health Administration (OSHA) published voluntary management guidelines to help organizations implement a safety and health program (United States Department of Labor, 1989). One of those fact sheets is on "Creating a Safety Culture" which describes Safety Cultures "consist of shared beliefs, practices, and attitudes that exist at an establishment. Culture is the atmosphere created by those beliefs, attitudes, etc., which shape our behavior. An organizations safety culture is the result of a number of factors such as:

- Management and employee norms, assumptions and beliefs;
- Management and employee attitudes;
- Values, myths, stories;
- Policies and procedures;
- Supervisor priorities, responsibilities and accountability;
- Production and bottom line pressures vs. quality issues;
- Actions or lack of action to correct unsafe behaviors;
- Employee training and motivation; and
- Employee involvement or "buy-in."

In 2005, the Health and Safety Executive (HSE) Human Engineering developed a safety culture inspection toolkit as requested by Her Majesty's Railway Inspectorate (HMRI). The toolkit was required to provide a pragmatic approach for the measurement of safety culture in rail organisations. The HMRI requested that "the approach should focus on a limited number of indicators that are known to influence safety culture." The five indicators are as follows:

- Leadership,
- Two-way communication,
- Employee involvement,
- Learning culture,
- Attitude towards blame.

The affect of the BDC proved useful in determining root causes of behavioural factors. In addition, the BDC engaged employees in new ways in regards to analyzing incidents, analyzing behaviours, and attitude towards blame. To some, the BDC at first glance appears simple, maybe "too" simple. In deed the purpose of the tool is to make analyzing human factors a simple process to enable any employee to do so.

In the case example provided in this paper, historically the investigation could have claimed the root cause to be "Operators fast pace during dipping," essentially blaming the employee for the incident itself. As can be seen in the why tree analysis by virtue of using the BDC checklist, the results yielded further causes to the employees fast pace – 1) variability of performance between operators, nature of the process drives pace, and undesirable and abnormal conditions encourage deviation of desirable pace.

In comparison to the definitions of Safety Culture noted previously, the BDC enabled culture change by improving attitudes towards blame, actions to correct un safe behaviours both of the front line and of leadership, and not mentioned previous enabling the organization to further develop into a learning culture by sharing this new practice.

Conclusion

The BDC proved useful in regards to ease of use and ease of identifying practical solutions. Although the information obtained from using the PDC is subjective in nature, it has proven valuable when attempting to design solutions to improve behaviours, conditions and systems in regards to Safety. When it comes to getting to the root cause, the author doesn't claim to have found a magic bullet, or to have unlocked the secrets of the universe. In short, the author hopes to have showed how simple tools can make for value adding solutions to unlock safe behaviours and make a positive impact to an organizational culture.

References

Austin, J., 2000. Performance analysis and performance diagnostics. In J. Austin & J. E. Carr (Eds.), Handbook of Applied Behavior Analysis (pp. 321-349). Reno, Nevada: Context Press.

Austin, J., Carr, J.E., and Agnew, J., 1999. The need for assessment of maintaining variables in OBM. Journal of Organizational Behavior Management, 19, 59-87.

Brown, P., 1982. Managing Behavior on the Job. John Wiley & Sons.

COX, S. & COX, T. (1991). The structure of employee attitudes to safety - a European example. Work and Stress, 5, 93 - 106.

Daniels, A. C., and Daniels, J. E. (2004). Performance Management: Changing behavior that drives organizational effectiveness. Performance Management Publications: Atlanta, GA.

Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northrup, J.,&Cigrand, K., 1992. Brief functional assessment techniques to evaluate aberrant behavior in an outpatient setting: A summary of 79 cases. Journal of Applied Behavior Analysis, 25, 713-721.

Gilbert, T. F., 2007. Human competence (Tribute ed.). San Francisco: Pfeiffer.

HSC (HEALTH AND SAFETY COMMISSION), (1993). Third report: organizing for safety. ACSNI Study Group on Human Factors. HMSO, London.

Health and Safety Executive (HSE) Human Engineering (2005). A review of safety culture and safety climate literature for the development of the safety culture inspection toolkit. Research Report 367. Shore House, Westbury-on-Trym, Bristol.

Horner, 1994. Functional assessment: Contributions and future directions. Journal of Applied Behavior Analysis, 27, 401-404.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S., 1992/1994. Toward a functional analysis of self-injury. Journal of Applied Behavior Analysis, 27, 197-209 (Reprinted from Analysis and Intervention in Developmental Disabilities, 2, 3-20, 1982).

Mager, R. & Pipe, P., 1970. Analyzing Performance Problems or "You Really Oughta Wanna." Fearon Publishers

Rodriguez, M., Wilder, D. A., Therrien, K., Wine, B., Miranti, R., Daratany, K., Salume, G., Baranovsky, G. & Rodriguez, M., 2005. Use of the performance diagnostic checklist to select an intervention designed to increase the offering of promotional stamps at two sites of a restaurant franchise. Journal of Organizational Behavior Management, 25, 17-35.

Rummler, G. A., & Brache, A. P., 1995. Improving performance: how to manage the white space on the organization chart (2nd ed.). San Francisco, CA: Jossey-Bass.

The Center for Chemical Process Safety (CCPS). Guidelines for Preventing Human Error in Process Safety, 2004. Wiley-AIChE; 1 edition (August 15, 2004)

United States Department of Labor, Occupational Safety and Health Adminstration (OSHA), (1989). (Federal Register Jan. 26, 3904 - 3916). https://www.osha.gov/SLTC/etools/safetyhealth/mod4_factsheets_culture.html

United States Nuclear Regulatory Commission (June 14, 2011). "Final Safety Culture Policy Statement." Federal Register, NRC–2010–0282, Vol. 76, No. 114.

Appendix A: The Behavioral Diagnostic Checklist (BDC)

Diagnostic Categories	Yes	No
Antecedents and Information		
1. Is there a written procedure for the task which the desired behavior should be demonstrated?		
2. Are job or task aides available and visible that illustrate the desired behavior and/or task steps?		
3. Have employees been provided information regarding safety methods to perform the task?		
4. Does the behavior and associated task have specific targets for performance (i.e., time limit, production)?		
a. Are these targets frequently updated, challenging, and attainable goals that employees are comfortable with?		
Equipment and Processes		
5. Is equipment up to date and "best in class" against industry norms from a safety standpoint?		
6. Are the conditions to perform the task optimally arranged in a physical sense?		
7. Has the task been evaluated from a safety stand point (i.e., Risk Assessment, JSA) in the last 5 years by an EHS professional and has been revisited within the last year?		
8. For Non-Routine tasks, was a Hazard Assessment performed prior to starting the task?		
9. Has the task been evaluated from an efficiency standpoint (i.e., Time Study) to assess for pace of task?		
Knowledge and Skills		
10. Have new employees been trained in the task within the last 6 months?		
11. Have "seasoned" employees participated in refresher training in the last 5 years?		
12. Are employees evaluated on their performance of the task in regards to safety, consistency and accuracy?		
13. Can the employees physically/verbally demonstrate completion of the task?		
14. Would employees say the task is not difficult to learn?		
Consequences/Reinforcement		
15. Would employees say the task can be performed safely, consistently and accuracy?		
16. Do employees receive feedback on their performance of the task through direct observations (i.e., BBS observations)?		
17. Is the ultimate outcome clear to the employees of this task?		
18. The employee can stay focused on the task with no distractions?		
19. Do the conditions encourage the employees to maintain high rates or long durations to performing the task?		
20. Is an observer or routine "check" required to ensure procedures are followed for safety or quality?		
Total Score (% yes)		