Barrier Analysis – Cold, Wet, and Alive [1]

by Robert B. Kauffman, Ph.D.

Barrier analysis is a conceptual cornerstone of the accident process and accident prevention. Although it is an important component within the Management Oversight and Risk Tree (MORT), it is a stand-alone analysis that is useful in identifying the accident process and in accident prevention. Using the analysis to identify barriers prior to the occurrence of an accident makes barrier analysis a useful tool in accident prevention. The following section is adapted from a technical paper titled *Barrier Analysis* by the Technical Research and Analysis Center (Trost and Nertney, 1995). It builds on the original work of Johnson (1973) and is in the current MORT User Manual (*NRI MORT User's Manual*, 2009).

Introduction to Barrier Analysis – The concept of barrier analysis is not difficult to understand. As its name suggests, the object of safety prevention is to place barriers between the target (people or objects) and the potential hazard to prevent the transfer of unwanted energy (Figure 1). All barriers are less than adequate (LTA) meaning that they are not 100% effective. In the MORT analysis, an incident is defined as an event where there is a transfer of energy and an accident is defined as an incident where an adverse consequence results. Assume you slip on a banana peel and fall to the ground. Hitting the ground after the fall (kinetic energy) is an example of a kinetic energy transfer. Other sources of energy transfer include kinetic, chemical, thermal, and electrical. If you dust yourself off, get up unharmed, and leave, it is an incident without injury, damage, or loss. If you break your arm from the fall, it is an incident or accident with injury, damage, or loss.

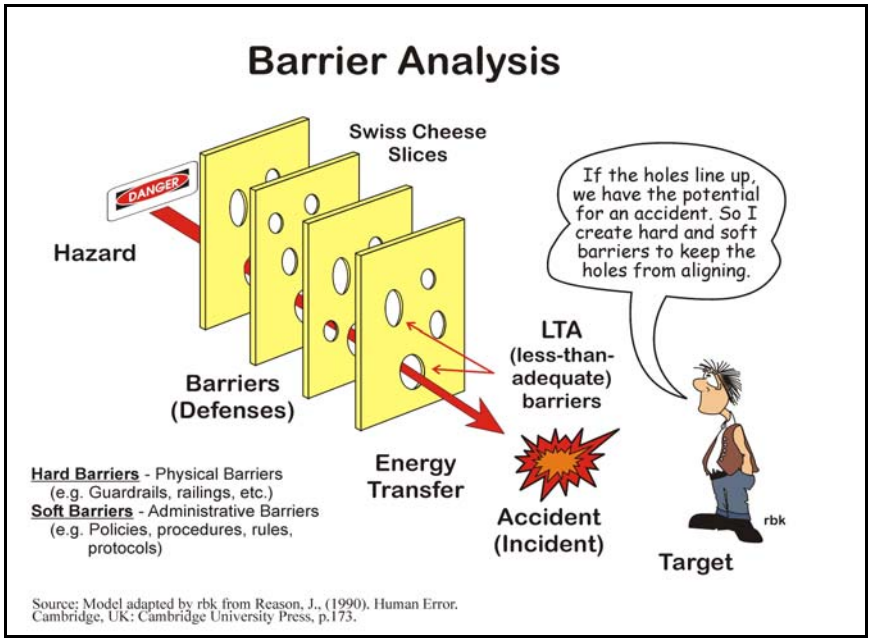

Figure 1: Barrier Analysis – Source: author [BarrierAnalysis03.cdr]

Barrier Analysis and Cold, Wet, and Alive (Figure 2) – In the video, David takes a canoe trip in early spring. Hypothermic, he falls into the water several times and eventually everything unravels. He loses his boat. On the trip, one of the hazards (dangers) facing David is hypothermia. Using the underlying factors in the accident process as a starting point, the following is a list of barriers (Swiss Cheese slices) that David and his group could have taken to reduce the likelihood of an accident occurring (i.e.

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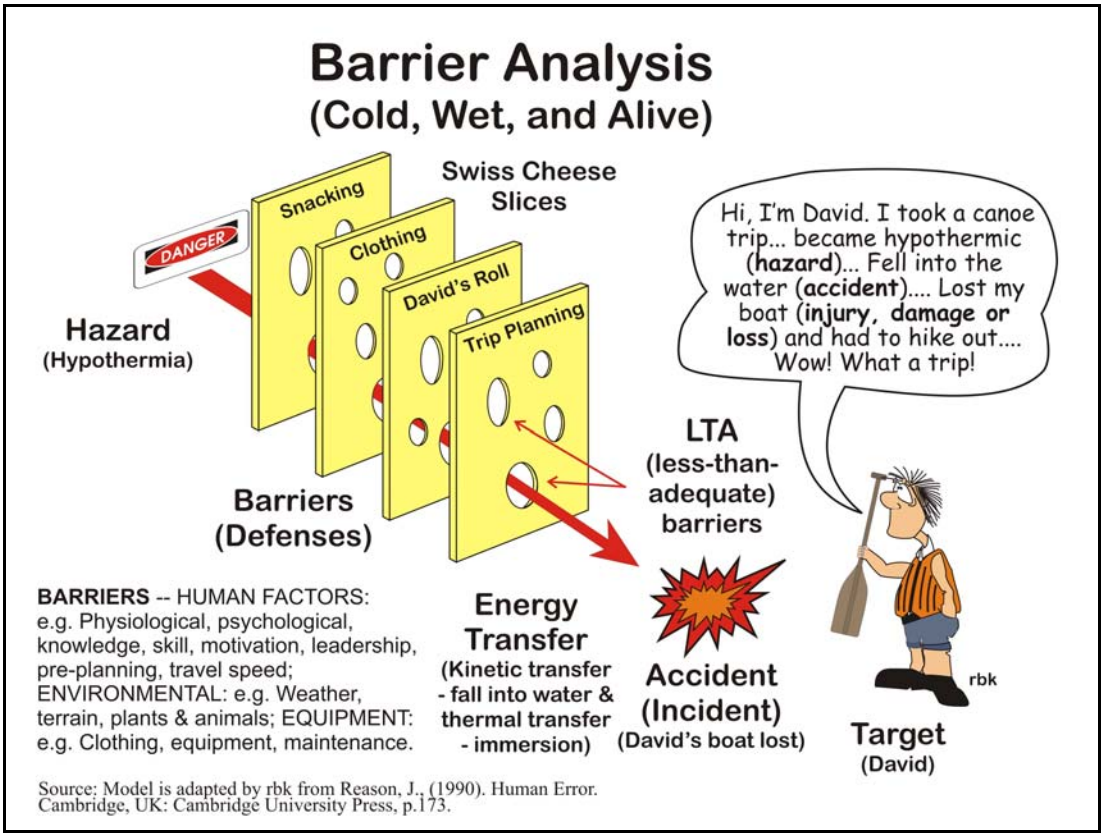

Figure 2: Barrier Analysis – Cold, Wet, and Alive. Source: author [BarrierAnalysis04.cdr]

energy transfer and injury, damage, or loss) (Kauffman and Moiseichik, 2013). It should be noted that good trip planning addresses most of these factors. The list is not inclusive of everything, but it is a good start.

Human Factors:

- David should have snacked and replenished his energy supply. (Physiological)
- David practiced his roll in the swimming pool over the winter. (Skill)
- Have a better understanding the Abilene Paradox and "group think" (Motivation)
- Have a better understanding the cultural norm of having to finish what was started (Motivation)
- Set the goal of the trip to have fun rather than complete the designated route. (Trip Planning)
- Leave a shuttle vehicle at the lunch stop bridge (Pre-planning)
- Know the rate of travel on a river, the length of the river, and put on the river at an appropriate time to complete the trip in daylight (Pre-planning)
- Know the pattern of the Sun in the sky during spring and plan for the late afternoon sun dropping quickly behind the mountains (Pre-planning)
- Review a guide book regarding the suitability of the trip for the group given their experience and skill levels (Pre-planning)

Environmental Factors:

- Incorporate the weather forecast into trip planning (Weather)
- Account for the cold water in trip planning (Terrain)
- Account for the river difficulty in trip planning (Terrain)
- Plan for changes in river flow during the trip (Terrain)
- Plan for changes in the weather during the trip (Weather)

Equipment Factors:

- Dressed for the water rather than the air temperature (Clothing)
- Bring along extra supplies of clothing (Clothing)

Each of the above items can be considered a barrier or metaphorically, a slice of Swiss Cheese in the model in Figure 2. Each of the above barriers is also LTA (less-than-adequate). They are not perfect. They are not 100% effective as barriers. The only 100% effective barrier is "avoidance" and not going on the trip in the first place. An example of a barrier is that Dean and Becky wore wetsuits. They still had heat loss and were mildly hypothermic. Their clothes were less-than-adequate in protecting them from the cold. They had the potential for an accident but didn't.

When David falls in the water for the last time and takes his swim, there is an energy transfer. The first is the kinetic energy of the fall which is relatively minor since he fell into the water. Second is the thermal transfer resulting from the loss of body heat from being immersed in the cold water. David suffered from hypothermia and he lost his boat. There was injury, damage, or loss. An accident occurred.

Barrier Identification Table (Figure 3) – Using the Barrier Identification Table in this section, you can formally assess the potential hazards and the barriers used to prevent or minimize them. Even if you don't formally use this instrument, you should consider using it as part of your thought processes where you identify the potential energy transfer associated with a hazard, the target and what you can do to prevent or minimize the incident from occurring. Its basic approach is a good way to think as a leader, programmer, or manager.

The instrument in Figure 3 is modified from the NRI MORT User's Manual (NRI MORT User's Manual) and an accident investigation tool originally developed by Oakley (2003). The first three columns identify the energy transfer (hazard), the target, and the barriers & controls. The basic purpose of the barrier and controls is to separate the energy from the target. In the fourth column, identify the purpose and how the barrier will prevent or minimize the energy transfer. The fifth column addresses the practicability of implementing the barrier.

Cold, Wet, and Alive and hypothermia are used as the example. In the first column, list all the hazards or sources of energy transfer that you can identify. In this example, it is limited to hypothermia. Other hazards or dangers can be added. Next, move to the third column and list all of the barriers that you identified within the system with which you are dealing. Listed in the third column are most of the barriers discussed within the previous sections. Although this isn't in line with the conceptual flow, most people will find it intuitively, easier. Then go back and identify the target or who needs to be protected in the second column. In this case, it is either David or the group. If you have different targets for the same hazard, consider sorting or rearranging the lines so that the common targets are grouped together for the same hazard.

In the fourth column, describe the purpose of the barrier or how it will prevent the energy transfer from the hazard to the targets. In the fifth column, note limitations to the barrier. Is the potential barrier feasible

or cost prohibitive? Both the hazards and barriers can be determined through brainstorming or through a logical tree analysis.

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Figure 3: Barrier Identification Table
Activity or Program: _ **David's Spring Canoe Trip** _____

Energy Transfer (Hazard) or harmful Agent, adverse environment condition	**Target** Vulnerable person or thing	**Barrier & Controls** to separate Energy and Target	**Purpose/Prevention**	**Limitations**
1. Hypothermia (thermal transfer)	David	Snacking	A partial barrier, eating food helps keep the fuel tank full and reduces fatigue.	Taking the time to snack.
	David	Clothing	Drysuits and wetsuits create a barrier that reduces heat loss in the water.	The greater the temperature differential between the air and water makes wearing a wetsuit more difficult.
	Group	Shuttle at lunch stop.	There are several barriers. It make the decision at the lunch stop easier. It redefines the goals of the trip. It indicates trip planning	It requires a third vehicle (one at the take-out, one at the lunch stop, and one to run shuttle to the put-in)
	Group	Eskimo Roll	Eskimo roll is self-rescue. Rolling creates a barrier by preventing a long swim.	Proficiency and experience on the river versus a swimming pool.
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Directions:
1) Identify the activity or program. This identifies the system level.
2) In Column #1, list all the potential hazards that can affect the program.
3) In Column #3, list the potential barriers or controls for each hazard. Consider the following barriers: equipment and facility, physical barriers, warning devices, procedures/work/protocols, knowledge and skills, attitude and culture, and supervision. (Conceptually, the flow is from Column 1 through 3. Most people will address the barriers and controls second, in response to the hazard.)
4) In Column #2, identify the target or the vulnerable person or thing.
5) In Column #4, indicate whether the barrier will prevent, control, or minimize the hazard. Indicate how.
6) In Column #5, indicate any limitations to placing the barrier in place (e.g. cost, feasibility, administrative feasibility, etc).
Source: adapted from Table 2 in NRI MORT User's Manual and Oakley (2003)