

REVIEWARTICLE

Applications of ADR (Accident Data Recorder) in Worksites

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ABSTRACT

Before, during, and after an accident in worksites, many of the details regarding why and how it occurred are lost. To prevent this from happening, Accident Data Recorders (ADR) can be used to record information over long periods of time. Due to their ability to be networked and the fact that many of these can be used to gather information about the same area (guaranteeing there is not a single point of failure if one fail), they can gather the most relevant information leading up to and after an accident. Similar technology already exists in different application areas but the lack of modularity, ability to network, and many other missing features makes them less effective at recording information. By recording all information relating to an accident, it can become much easier to understand how to prevent another accident in the future. This can not only save money but the lives of employees.

KEYWORDS: *Accident data recorder, ADR, Root cause analysis, Black box*

INTRODUCTION

Accidents happen every year in different worksites around the world. Sometimes they result in little damage or injury but other times the damage can be catastrophic. Accident investigation and Root Cause Analysis (RCA) were created to try and understand why these accidents happen and eventually come up with solutions to minimize the chances of other happening in the future. To understand why the accident occurred requires utmost information about the events that can be recorded as well as necessity to know that the information is reliable. Accidents are

either chaotic which causes information to get lost quickly in the chaos if recorder is used, or they take place over many days or even months meaning that not all of the information was recorded as recorder space is limited. Without vital information, it becomes much harder to prevent future accidents. To prevent information from being lost, Accident Data Recorders (ADR) could be utilized to record data over long periods of time without the information becoming unreliable thereby helping those doing accident investigations.

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The purpose of this work was to explain about Accident Data Recorders, where this technology could be applied (in what settings), what previous works have already been done on a work like this, what information is missing from those previous works, how to plan to do the work (what techniques need to use), what equipment and software need to be used to produce this work, findings and results from the work, and recommendations for the remaining works.

One major issue with accidents is the complexity of gathering all required information required to understand what happened. This can make it very difficult to understand how to prevent another incident from occurring in the future. To prevent the lack of information, a single source is needed to gathers all the details before, during, and after the accident. This source needs to be able to hold information for years, hold large amounts of information, be capable of withstanding a disaster, needs to operate during a disaster, not get in the way of workers, keep information reliably and without bias, consume a low amount of energy to function, be able to record information from all kinds of machinery and computers, have many different types of sensors, be modular with the ability to adapt to any kind of environment or design, and it should be cost-efficient. All of these needs can be met with an Accident Data Recorder (ADR).

Due to ADR's reliable nature and the ability to keep lots of information for a long period of time, this device will help investigators understand what happened during an accident and why it happened. This is important because once investigators have understood why an accident happened, they can save the lives of employees, money, reputation, and resources of an organization by preventing another disaster from occurring.

LITERATURE REVIEW

Any field that is even tangentially related to safety or has a need to hold information for safety reasons could benefit from this technology. Many businesses and government entities could use this technology to record information and keep their workplace safer. These various organizations would be able to keep their workers safer and make the

workplace a much safer environment. The Accident Data Recorder (ADR) could also prevent the loss of reputation, resources, employees, money, and other resources by preventing accidents from occurring. Therefore, how does it accomplish all of these important feats need to look at.

Organizations won't lose reputation from being seen as unsafe or uncaring because the rate at which accidents occur will be much lower due to ADR use [1]. The loss of reputation from the public and the workers won't be as much of an issue as it would be otherwise. This will also increase worker morale due to workers having a better view of their organization.

The organization could even be known for its safety techniques, giving it a positive reputation. As the business or organization increases in reputation, it will find a greater number of applicants leading to less hiring costs and better-quality workers: "Executives know the importance of their companies' reputations. Firms with strong positive reputations attract better people.

They are perceived as providing more value, which often allows them to charge a premium. Their customers are more loyal and buy broader ranges of products and services. Because the market believes that such companies will deliver sustained earnings and future growth, they have higher price-earnings multiples and market values and lower costs of capital".

Other companies might also take notice which will make them much more likely to work with the business as they could feel that the business is more reliable and less likely to have an accident occur. The business in question will also see the prices and demand of their products and stock go up as people view their company as more reliable and less likely to fail: "Moreover, in an economy where 70% to 80% of market value comes from hard-to-assess intangible assets such as brand equity, intellectual capital, and goodwill, organizations are especially vulnerable to anything that damages their reputations".

Company or organizational resources won't need to be used on the cleanup of disasters where the difficulties involved with resuming work after a disaster or near miss occur. Workers will also work faster in environments that are safer and more efficiently if the workplace is safe and doesn't stop due to production having to halt: "An unsafe health facility

environment such as unsuitable furniture, poorly designed workstations, lack of ventilation, excessive noise, inappropriate lighting, poor supervisor support, poor workspace, poor communication, poor fire safety measures for emergencies, and lack of Personal Protective Equipment (PPE) can adversely affect the productivity of the employee” [2].

In Figure 1 Pie chart displays some of the benefits of a safer workplace. Not only were workers more satisfied with their job, they also had greater morale. This also helps to increase worker retention while reducing costs and increasing overall productivity [3].

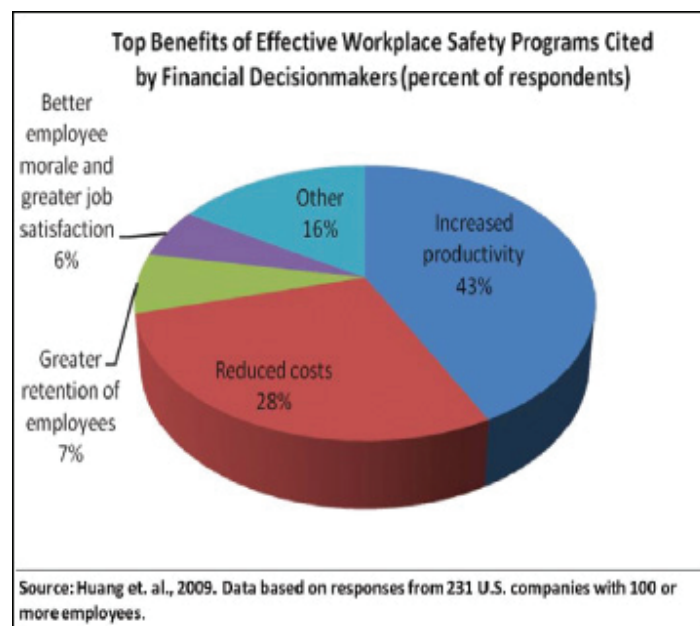


Fig 1. Benefits of a safer workplace [3]

This isn't the only important feature or effect that the Accident Data Recorder (ADR) will have in the workplace. Employee chances of injury or death will drastically decrease due to the employer's ability to gather information on previous disasters or near misses and will have a better understanding of what went wrong. This will decrease the chances of a repeated event and could even warn of similar events that could occur. Loss of money due to having to shut down work because of an accident won't happen as often and having to pay for damages to equipment, employees, and lawsuits should become a much rarer occurrence. In some businesses such as construction, costs due to injury can be very high: "The average WSIB cost of one lost-time injury in construction is \$35,000. In most cases, direct costs are covered by the WSIB and therefore have little or no immediate impact

on profits. But they do impact on future profits since they drive up the cost of doing business. Indirect costs include disrupted work schedules, lost productivity, clean-up and repair, hiring and training replacement workers, bad publicity, and time spent on accident investigation claims management, and litigation" [4]. Indirect costs from injury, work issues, and other problems can be as high as five times more than direct costs: "CSAO has found that the average ratio of indirect to direct costs in Ontario construction is 5 to 1. Indirect costs exert an immediate impact and usually result in lost profits [4].

In Figure 2 the graph displays the financial costs associated with worker injury [3]. Costs associated with injury seem to keep rising overtime. Keeping workers safe with negate these costs significantly [3].

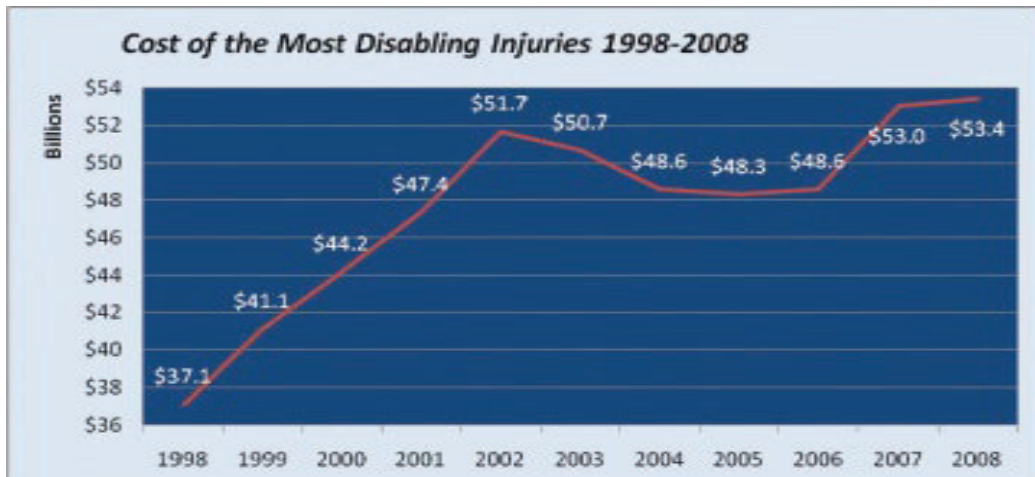


Fig 2. Cost of injuries overtime [3]

Not only a company saves money by saving the lives of the workers but also reduces the risk of losing employees with unique skills and talents that are rare which would make finding workers capable of working at the same level of skill and ability extremely difficult.

There have already been similar works that have been done in the past. These were typically known as “black boxes” (a name that is typically used by the public). The devices have been around since before the 1960s. They used magnetic tape to record information, usually in an aircraft: “Older black boxes used magnetic tape, a technology that was first introduced in the 1960s. Magnetic tape works like any tape recorder. The Mylar tape is pulled across an electromagnetic head, which leaves a bit of data on the tape. These days, black boxes use solid-state memory boards, which came along in the 1990s” [5]. The devices were built to withstand significant amounts of

force (enough to survive most crashes) and they held data from many instruments so that should something go wrong, they could find out what caused the issue to occur. Although they are typically referred to as “black boxes” they are usually painted bright orange so that if there is a disaster, they can be seen more easily in the wreckage.

Accident Data Recorder (ADR):

Accident Data Recorder (ADR) that needs to be used in worksites, will use the concept of ‘Black Box’ which is mostly used in aero planes. In Figure 3 shows a flight data recorder from a crashed EgyptAir from 1999 [5]. This black box uses magnetic tape to record information so that it may be read later. An electromagnetic head records information on the tape.

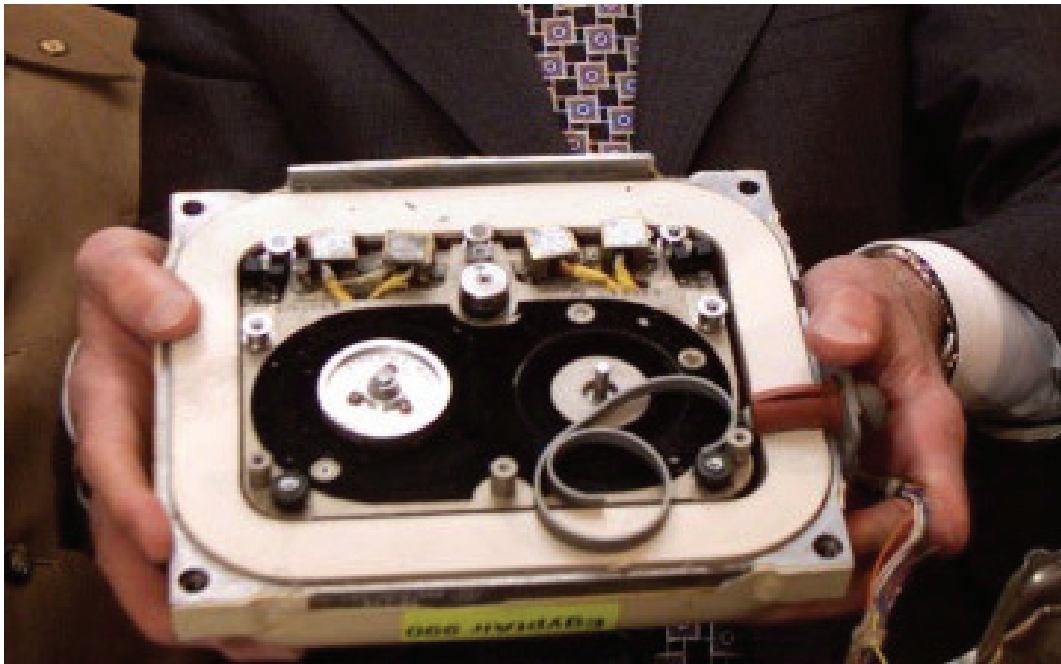


Fig 3. Flight data recorder from EgyptAir in 1999 [5]

Although the previous “black boxes” were incredibly useful, they lack modularity and couldn’t be easily applied to a wide variety of devices. They also could not be networked to gather information from a wider variety of sources. To gather more information more reliably, they need to be able to be compatible with large numbers of different types of equipment and be relatively small. It should also be modular in nature,

allowing it to have different sensors and devices depending on the job that needs to be done.

Accessibility to recorded information in black boxes has been shown in Figure 4 [4]. This black box lacks some of the modularity and ease of access. A black box could be accessed wirelessly or without multiple tools e.g.: plugs directly into computer vs needing a tool so that a computer can access the data [6].

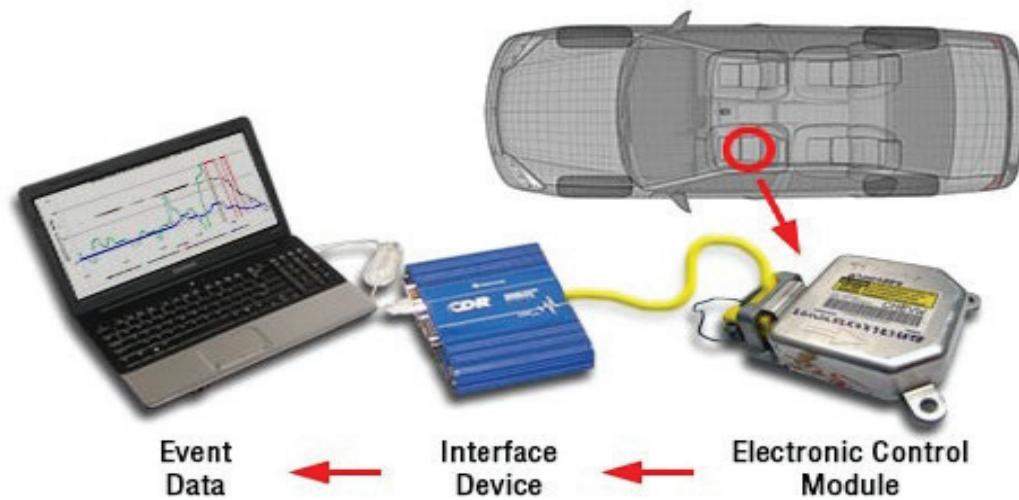


Fig 4. Accessing of black box [6]

To do this work, using the knowledge that have gathered over the years and skills that acquired while doing other works that were similar or at least required the same set of skills. The research needs to be done so that accumulation of knowledge can be collected before putting all of the details into a single document. This will take a while so need to be smart with time by maximizing efficiency to get the work done quickly while creating a quality final product. To do this, also need to take advantage of the various tools, software, travel, and more to complete this.

DISCUSSIONS

ADR can be used or installed near to each major equipment which due to its failures can cause accident. ADR can be placed in a safe place covered by high impact resistant, fire retardant material box (similar to Black Box in aeroplane) which cannot be

damaged even due to explosion, fire, liquid leak etc. The box should not be accessible by everyone (general people), only investigators should have access to that box. The box need to be tested by the manufacturer before available to use to ensure its operability.

With the present safety technology on machine safeguarding so many safety features are added to warn the employee that something is wrong with him/her (human error) or unsafe condition exists with the equipment. A popular technology that is used with equipment or machine is interlocking devices that have been used to prevent any unsafe act, condition or equipment. The interlock can be made to operate a clutch or brake device, thus controlling the operation of certain parts of the machine. The interlock is tied into controls that will only allow the machine to operate in a safe manner [7]. Figure 5 and 6 are depicting interlock switch on sliding and swinging gates, respectively.



Fig 5. Interlock switch on sliding gate [7]



Fig 6. Interlock switch on swinging gate [7]

Unless the user addresses the interlocking devices, the user cannot use the equipment. An inattentive employee (which indicates human error) can modify the interlocking arrangements due to complete or finish his/her work, while keeping unsafe condition to him/her or other employees who is working near to that machine or will use later. Overriding the interlocking device can cause accident eventually at the long run. ADR can record all the information related to the time, day or necessary information when interlocking was placed in addition to overriding information, the equipment behavior (vibration, sound, temperature, heat generation etc.), PH level of liquid spill, gas leak etc. near to the equipment. Later investigators can look at those information, can analyze the data, and find proper

information from ADR by whom, when, where, and how accident happened.

ADR can also send signals to the supervisors of that employee who is having interlocking in placed during his work, when and how he modified the interlocking arrangements etc. That information can give indication for the supervisor to train the employee to follow proper guidelines related to establishing safe work environment or address any problem before any accident can happen.

Figure 7 shows event correlation flow chart for these processes to show how ADR can perform in worksites. The whole process can work so fast that line management can take care of this situation quickly to ensure that safety is not compromised.

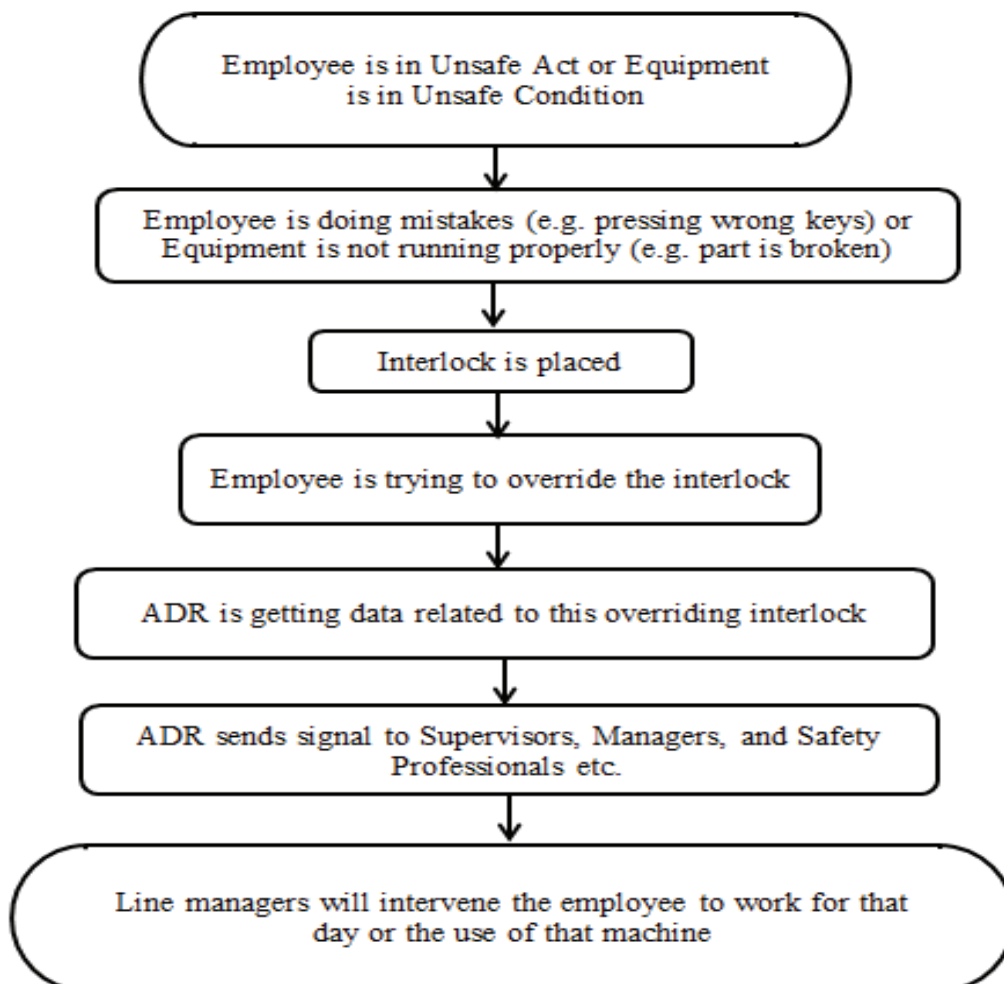


Fig7. ADR for unsafe act and condition event correlation flow chart

Similarly ADR can be used in other safety technologies on machine safeguards embedding in machine and equipment for any irregularities. The results of using ADR will be phenomenal as accurate information related to accident can be obtained which eventually will help the employers as well as investigators to save their cost, time, and resources (CTR). An employee who is not in his mind in that day can be sent to training to learn how to physically and mentally fit to operate a machine. Supervisors will get appreciation from their employers as they prompted to take actions before any accident could happen. They will also get information what need to be added in the training materials related to how not to operate a machine when unsafe act and condition arise.

Tools like Microsoft Word, PowerPoint, personal computers, cell phone, desktop, and car will be used to complete this work. Need to utilize the computers to gather information online and compile the information for a work and presentation. Microsoft Word will be the program that compiles all the data, analysis, and conclusions. For miscellaneous tasks, need to use personal vehicle for transportations. Finally, to record the presentation, need to use cellphone and the camera function that it has.

With this device, businesses and companies will experience fewer disasters, injuries, and death. This will lead to increased efficiency in the company while also saving money. Ultimately, this will be a low-cost product compare to the amount of loss which can save a significant amount of money and lives.

CONCLUSION

Due to the excessive benefits and very little drawbacks, suggestions need to make that companies and businesses invest in this ADR as soon as possible. The quicker they start utilizing multiple accident data recorders, the more resources the company will save. Also, by using it before other companies have invested in it, they could become leaders in their field and gain significant advantages in the market and in saving human lives.

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