



# SYSTEM SAFETY SERVICES

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Canadian Nuclear Safety Commission

Re Human Performance Discussion Paper DIS-16-05

## Epilogue

It is with pleasure that I have this opportunity to join the discussion on Human Performance. After 56 years in aviation, I have all too often seen the tragic results of human error. In almost every case: it did not have to happen.

The Aviation and Nuclear industries have many things in common but the two big similarities I will focus on are they are both high consequence industries and they are both run by humans who are subject to human error. Like the aviation industry, nuclear quotes the 80% of incident/accidents have their origins in human error. Based on that premise I will focus mainly on how to reduce that percentage.

## My Background

Here is a short bio to help you understand where I am coming from. I attended Victoria College for two years on a pre-med course before volunteering for the missions in New Guinea in 1960. There I did everything from pulling teeth and teaching, to building an airstrip and flying. I returned to Canada in 1963 after being injured, where I worked for the Catholic Welfare Bureau as a social worker for a year. I owned my own business which I sold with the intent to return to New Guinea. I got married, completed a planned aircraft maintenance course and received my Airframe & Powerplant (A&P) license before returning to New Guinea to maintain and fly aircraft. On returning to Canada in 1973, I worked for West Coast Air Services, then CPAir, before becoming the principal of PVI, an aircraft maintenance vocational school. I worked for Crown Forest as their Director of Maintenance before joining the Canadian Transportation Safety Board (TSB/C) as an accident investigator in 1986. I left the TSB/C after 7 years to join Transport Canada as a Special Programs Coordinator with the task to develop an

aviation maintenance equivalent to the pilot Crew Resource Management (CRM) human factors training.

With the help on an Industry Liaison Committee a two day workshop was developed under the name of Human Performance in Maintenance (HPIM). I left Transport Canada in 1999 to continue this work to this day as CEO of System Safety Services which I still do to this day.

### **To answer your questions**

**#1.** Do you agree with the definition as stated above? Are there changes or alternative definitions you would propose?

#### **Response #1**

As they say: “there is more than one way to skin a cat.” I agree with the definition, but we break it down to performance and judgment.

Performance is the way that you carry out a task while judgment is what made you determine that the way the task was completed was the best way at that time. This may come from the investigation days in which a task is performed as it usually is, but something interfered in the judgment to cause a human error.

In order to encourage a paradigm shift in human error judgment we have adapted a pilot error quote from Jerome Lederer, President Emeritus, Flight Safety Foundation

#### **[MAINTENANCE] ERROR**

is **not** the cause of an accident

The cause is to be found in whatever  
it was that interfered with the

**[guilty party's]**

**{performance-judgment}** at a critical moment

the **outcome** (result) of which was a

**[maintenance] error.**

Our motto is “to honour our audience” and to this end we strive to keep it as simple as possible in order to ensure they will accept the overall concept. The participants that our training was developed for have had no physiological training and were very prejudice against any “psychobabble.” Your audience may be different.

**#2.** Do you propose any changes or alternatives to the CNSC’s existing definition of human factors? Please provide rationale for any proposed changes or alternatives.

## **Response #2**

I have no problem understanding the explanation which may be perfect for your trainees. The very simple explanation we use and our participants have no problem understanding and accepting is: human factors are the contributing factors that cause us to do the things we do. Provide them with a few “war stories” of how a hard working person like themselves made a simple error that they knew not to make due to say; the contributing factors of fatigue and pressure and they will understand, accept and perhaps even remember.

**#3.** Do you agree with the objectives and practices of a human performance program listed above? Are there items that you would add or remove from the list? Please explain.

## **Response #3**

Those are all excellent objectives, but the “meat” is in how they will be achieved. I would simply state:

a) Train the person on how to avoid making the error they never intend to make utilizing the “Dirty Dozen” contributing factors to human error, and b) develop a Safety Management System (SMS) to lower the hazards to Safety to ALARP (As Low As Reasonably Practical). The training is actually part of a SMS so this could be a single objective with the How to be explained later.

**#4.** Do you agree with the elements of a human performance program listed above? Are there items that you would add or remove from the list above? Please explain.

## **Response #4**

While I agree with the elements listed I do not agree that they should be separate entities that compete for resources. For too long Safety in aviation has been in silos for flight crew, cabin crew, maintenance, ground crew, etc.

The logic was that pilots made most of the mistakes and thus, got the bulk of the attention. Often they were the last ones to make a mistake, but just happened to be the last link in the chain of events. I would review at the whole concept and develop a Safety Management System that covers all aspects of Safety within an organization. Attached is a model that was developed in 1995 and called the “Big Picture”, for want of a better title at the time.

I say a SMS is: “A formal, systematic error reduction, accident prevention program, that manages the Safety risks through ALL aspects of the company.” Safety has to be seen as everyone’s responsibility to truly be successful. Think of it as being a giant funnel with all the risks to Safety thrown in. At the bottom end they are sorted out for various departments and analyzed for risk. The corrective action plan is then delegated to the responsible department with results kept in the SMS. Only then can an organization have a true Safety culture and a clear picture of all its risk to Safety.

**#5.** Do you agree with the concept of a human performance program described above? If you would propose other ways of viewing a human performance program and its elements, please describe them.

**Response #5**

I would propose that a SMS with the above objective be implemented. The human error element will be lessened by training the person on how to avoid making errors using the Dirty Dozen as well as setting up a reporting system to capture the hazards that must be analyzed for risk to ensure that they are ALARP.

**#6.** Do you think that the requirement to have a human performance program should be applied using a graded approach to all CNSC-licensed facilities and activities? If so, what might this graded approach look like?

**Response #6**

I don’t see Safety having a graded approach as large or small. They all have the same humans who make unintentional errors and unseen hazards that, when released can cause undesired consequences. In other words, the same training and Safety measure requirements should apply to everyone while the means of accomplishing them may be different.

**#7.** Which type of human performance program (A formal program or otherwise) is most appropriate for the types of nuclear facilities most relevant to your comments and why?

**Response #7**

A formal human performance program such as the aviation HPIM that has been adapted to reflect the differences in the two industries. The program must relate

directly to the type of work being carried out and facilitated by facilitators who have “walked the line,” are passionate about lowering human error and have the required experience and credibility. Experience has shown that all different HF workshop training has about 70% in common. Anyone in the industry can attend any workshop and learn as long as they understand the industry (and are human). A new module that is now becoming common in CRM is resilience. We have used a version of this in being mentally prepared. Resilience training and quick thinking can mean the difference between a major accident and a minor event.

**#8.** Do you propose any additional or alternative expectations of a human performance program?

### **Response #8**

I certainly hope so. We humans are famous for “reinventing the wheel.” I feel that what has worked for aviation will work for the nuclear industry. Before I delve into what has worked so well for our industry, I’d like suggest a few givens that I hope we can agree on.

### **A Few Givens:**

1. No one makes a human error on purpose;
2. Some of the worst errors can be made by the best and most experienced workers
3. Often the “guilty party” has no idea how he came to make the error;
4. Very often, the “guilty party” will punish himself more than the organization;
5. We must train the person to understand why people make errors and what they can do to avoid making errors;
6. Except in cases of reckless error, discipline serves no useful purpose;
7. Reckless error occurs when the individual knows there this a significant danger in what they are doing ,but chooses to do it anyway;
8. No Safety Management System can be truly successful without a “Just Culture” where the “guilty party and everyone else know they will be treated fairly;
9. The level of guilt should never be tied to the level of damage caused;
10. Human errors don’t cause accidents – refer back to page two as to why;
11. If the root cause is not determined, the occurrence will be repeated;
12. Safety is everyone’s responsibility and all must know that and act accordingly;
13. If you want perfection, you’ll have to die and go to heaven, but that doesn’t mean that you shouldn’t strive for it. This is an oft-used quote from my father that I try to live by.

## **The Big Picture (aka Safety Management System)**

In its very simplest terms SMS is putting a system in place to “sweat the small stuff (hazards) so you never have to sweat the big stuff” (accidents).

The following is a paper delivered at St Louis University in 2005 to a group of medical professionals at a conference. I will let it explain the model.

### A SAFETY MANAGEMENT SYSTEM THAT DEVELOPS A SAFETY CULTURE

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The aviation industry and its regulators are now turning towards some form of Safety Management System or SMS as the next means of lowering human error and thus, the accident rate. A Safety Management System is a **formal, systematic, accident prevention program that manages Safety risks through all aspects of the company.** The underlying end goal of SMS is to cause the company to develop a “Safety Culture” without destroying the “bottom line” (profit). The following is a SMS that can do just that.

The model that will be presented was developed with the assistance of the aviation industry in 1995 in order to understand where human factors training fitted in.

A human factors training program for aviation maintenance personnel was developed in Canada in 1993 in order to answer one of the recommendations made by Justice V.P. Moshansky in his inquiry into a fatal airline accident. At that time there was no legal requirement for any company to do this training and thus it appeared to be an orphan with the only justification for a company to carry out this training was a gut feeling that it was the right thing to do. Continental Airlines was the only airline doing any form of human factors training for its maintenance personnel at the time.

The model (See Appendix A) was developed to illustrate how human factors training played a key role in developing what was then called “The Big Picture.” Let’s look at the various pieces of the puzzle and their relationship in a SMS.



#### **Human Factors Training**

**Human factors training** is in the middle of the picture because it interfaces with all the other pieces of the puzzle and is a key piece. This training will have a positive impact on the rest of the picture but it’s only one piece of the complete picture. By itself, training will assist the person on the floor to avoid an error he/she never intends to make but it can do a lot

more to reduce errors to As Low As Reasonably Practical (ALARP).

The **human factors training** has to relate to the personnel and what he/she does. This is being accomplished in many companies with the incorporation of the Human Performance in Maintenance or Ground Crew (HPIM) Part 1 workshops. The **human factors training** is the key to any SMS as it provides everyone with an understanding of why good people including themselves can make errors and will help the rest of the puzzle pieces to fit together.

Some important points to know about the training are:

1. It will assist with the implementation of the other puzzle pieces
2. Thus it should be one of the first to be implemented
3. It needs to be ongoing and not a one shot deal to remain effective
4. All personnel require the training, from the CEO, management, maintenance, pilots, secretaries, stores, even the janitor.

Since over 80% of all aviation accidents are due to human error, it is very important for all to know what they can do to reduce this number. The right HF training will assist in the “buy-in” of the rest of the SMS.



## Company Culture

A **Company Culture** can be difficult to measure but is a key component of a SMS and a Safety Culture. A **Company Culture** is regarded as “*the way things are done around here*” while a Safety Culture must have these key elements. It is a company where:

- ✓ all believe that Safety does not have to come at the cost of productivity or profit
- ✓ Safety is treated seriously by management
- ✓ Safety is an integral part of the way the company operates
- ✓ all company employees are trained and encouraged to think and work Safely
- ✓ Safety goals are set and all work toward their achievement
- ✓ the company has a framework to accomplish the above (Safety Management System)

## Components of a company Safety Culture

### a) Mission Statement –

1. Does your company have a mission statement?
2. Does it relate to the day to day reality of the workers?
3. Does it include the word Safety in it?

Check yours and see if it meets these three criteria.

### b) Safety Policy –

1. Does your company have a Safety policy?
2. Does it spell out everyone's responsibilities?
3. Is it proactive?
4. Is it seen everywhere?
5. Is it signed by the CEO and other persons of high accountability for Safety?
6. Is it reviewed periodically?

All the responses must be positive in a true Safety Culture.



## Human Factors Incident Investigation

A **human factors incident investigation** calls for looking beyond the man and asking “why” until there are no more “whys.” It calls for looking at the “preconditions” and management latent conditions that may have contributed to the “active failure.” (See Appendix B) Studies by Boeing indicate that 70% of the time, when a human error is made (active failure) the fix (Safety Nets) is in the management latent conditions. This based on their MEDA (Maintenance Error Decision Aid) investigative tool results.

For the **HF Incident Investigation** to work there must be trust that being open and honest will not result in disciplinary action except in clearly exceptional cases. Thus, this module must include an

## Administrative Policy –

The administrative policy will spell out that it wishes to learn from our errors and as such will treat normal human error and even negligence as learning outcomes. Only recklessness will result in a disciplinary outcome. Thus, human errors will for the most part be treated as learning outcomes.

For Example

**Normal Error** - The unintentional forgetting to do something or doing something the wrong way. There was no intention to make the error.

i.e. Forgets to put the oil cap back on or forgets to put the landing gear down.

This is the majority of human error and is treated as a learning outcome, i.e. What can we do to prevent it from happening again?

**Negligence Error** - The persons knows he should do something but fails to do so thinking there is little or no risk in what they are doing. This is harder to treat as a learning outcome, but the key here is “*Did the person realize the risk in what they were doing?*” i.e. a pilot fails to visually check the fuel prior to departure even though the regulations say he must, as he knows that it was full the night before and they are running late. Besides everyone does it at times.

The error made was intentional but the person failed to recognize the risk. Often, the same action had been taken with no adverse results and the reason for the error was to benefit the company, not the individual. Here a very useful learning outcome can be obtained.

**Reckless Error** - The person knows there is a significant risk and chooses to do it anyway. i.e. The pilot chooses to over-fly an airfield even though both his fuel gauges read near empty or a person chooses to come to work drunk. Here the person made a conscious decision to disregard the consequences that a normal person would never do. There still can be a learning outcome but discipline may be required.

Even then ask these three questions in determining the amount of discipline:

1. Was the act deliberate with a reasonable knowledge of the consequences?
2. Does the person accept responsibility?
3. Is the person likely to do it again?

Keep in mind the purpose of discipline is:

**to ensure that it doesn't happen again.**

The administrative policy is not an easy one to develop but is a must if the employees are to trust the management and come forward with their errors and near errors.

If it is perceived that to admit to an error will likely result in punishment, then the SMS will have a major flaw. Every employee wants discipline as the group sense of justice does not like to see a unrepentant risk taker get away with a callous disregard of the regulations. This very small minority is in the wrong vocation if they fail to see the error of their ways.

If they are part of the problem, they can be part of the solution or they can depart.

Everyone must know where that line is.

Because discipline will rarely be required from a **HF Incident Investigation**, it should be a small part of the Administrative policy.

### Reporting Policy

A SMS requires a reporting policy in order to learn from near incidents before they become an accident. These can be called “Free Lessons” as they enable an organization to take corrective action without having the accident that precedes most corrective actions today.

This policy will serve to bring to light Hazards (anything that has the potential to cause you grief) that can then be analyzed for risk. This policy has to be non-punitive except for the exception spelled out in the administrative policy and it has to be widely understood and believed by all in the company.

### Incident Data Analysis

Another important part of the SMS is the **Incident Data Analysis**. We are very adept at keeping close track of failures in equipment and this data has enabled us to predict with reasonable certainty, when a part is likely to fail.

We must now begin to do the same with human error. At first thought, this appears to be a daunting task. Yet it is in this area that 70 to 80% of all accidents causes devive from and where a regulatory body will look as their major basis of determining if your SMS is working as desired.

If the database is empty or near empty. It is not working.

If the database is full but with many repeat incidents. It is not working.

If the database has a reasonable number of entrees with recommendations carried out and very few repeat entrees, then the database analysis is working.

The properly used database will provide a clear picture of where the most errors are occurring and where to prioritize resources.

The free lessons will provide the opportunity to come up with a solution before the problem becomes an incident.

### Risk Assessment -

The use of the database will call for a formal risk management procedure to determine and deal with the most hazardous of hazards first.

When hazards have been identified, there must be criteria and a system to assess the level of risk. This usually is expressed in terms of severity and probability. Some will also add frequency or level of exposure. What must also be looked at is the benefit. When risk is taken it is usually for a benefit and it should be looked at to arrive at a Risk Quotient.

The risk quotients should then be prioritized with cost vs. benefit analyzed.

The database will indicate what is working and what requires a different solution or more resources.

The database can indicate where more training is appropriate as well.

Used correctly it will play a big role in lowering the incidents that can lead to accidents.

Remember: Anyone can make an error but only a fool (individual or company) makes the same mistake twice.

### Feedback

Every piece of the puzzle is important but **feedback** is a must if the SMS is to work. All the other pieces can be in place but without employee participation, it will be doomed to be just another failed experiment. People need to feel that their thoughts and ideas are being considered and so they should be. They are the ones that, as they say, “*are at the coalface*” and have information that management has no knowledge of.

They are the ones who live the policies and have to make them work or work around them.

They are the only ones that can make a SMS work.

#### a) Goal Setting -

Management must set a Safety goal that is reasonable and attainable. (i.e. A 30% reduction in error damage within the next five years) Everyone must know and be actively working to achieve this goal.

#### b) Measure of Success -

There must be a means to measure the success of the initiative. The usual way is to compare error costs in the past with present costs. An increase in hazard reports is a measure of success. Safety actions implemented are another measure of success. All these should be made known to all the stakeholders.

An occasional Safety Review (rather than audit) with a Safety survey can help ensure that nothing is being ignored, missed or misunderstood.

**Feedback** will serve to educate and promote the vital teamwork that SMS requires. A bonus from positive **feedback** is improved morale of employees which translates into improved productivity.

**Feedback** can be in the form of a regular Safety meeting of all if the company is small to a regular newsletter that is devoted to Safety. Company newsletters are a modern day must. They should serve to inform, educate and motivate.

Positive **feedback** pays dividends for everyone. Even when an error occurs, we can let everyone know in order for him/her to avoid making the same error. It can take a lot of nerve to air the laundry, but if it is a lesson we can all learn from, then it should be there.

Educational articles should also be part of the newsletter in the form of simply written articles on topics like stress etc.

Cartoons can be a part of it in order to encourage reading.

Letters to the editor should be encouraged with questions being answered. Stats on how we are doing are just one of the means of helping to make the employee feel that he is an informed part of the company.

### **Emergency Response -**

In spite of everyone's best intentions, there will be occasions when an error is made. If the error is major then a recovery plan must be in place. This recovery plan is better called an **Emergency Response Plan (ERP)**.

The **ERP** can be critical to the survival of the organization. It must spell out what must be done and who will do it in the unlikely event that a major accident occurs. It is very important that **ALL** employees know their role in the plan. Every person has a role even if it is to know who to refer new media enquiries to rather than comment themselves.

**Feedback** to the employees is also critical at this point and if there are company fatalities, grief counselors may be required to assist employees closest (or perceive they are) to the error cause.

The **ERP** must be practiced and revised as necessary. It must be periodically updated to ensure the contact numbers, persons and procedures are current.

It is something that everyone hopes is never required but if the unthinkable does occur, the company and all its employees will be able to say with all honesty: *I don't understand how this could happen as we are always striving to be the safest we possibly can."*

### **Some Conclusions**

The arrows in this model go endlessly around the circle indicating that the whole exercise is not a one shot deal, but must be constantly worked on to improve.

Like any initiative, it must have complete management support in order to be successful.

It will take about two years to completely implement the system.

A Safety Management System is the next logical step to tie in previous initiatives into one homogenous system.

If you implement a SMS as designed, you will have a Safety Culture within your organization where everyone takes Safety seriously.

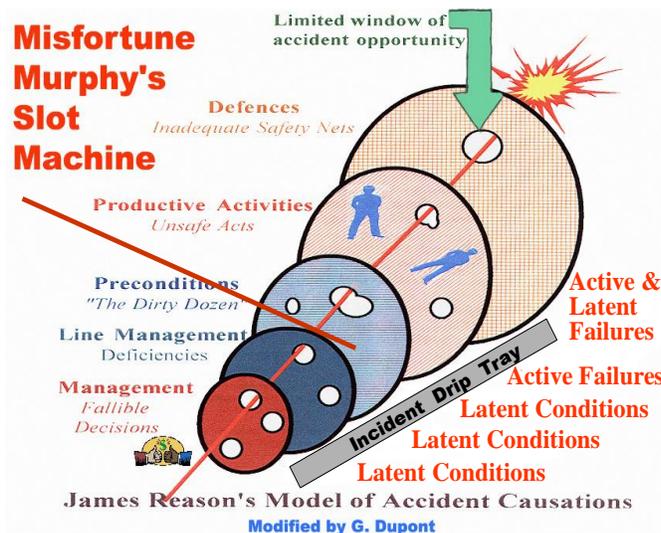
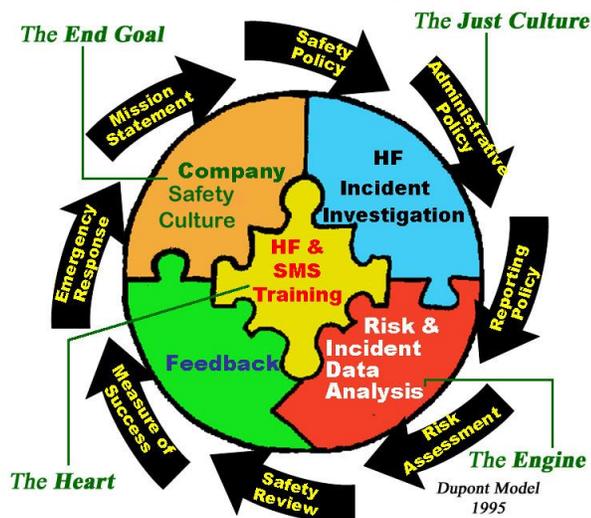
### **References**

V.P. Moshansky (Commissioner), Commission of Inquiry into the Air Ontario Crash at Dryden, Ontario: Final Report. Technical appendices. Ottawa, ON: Minister of Supply and Services, Canada.

James Reason Human Error Cambridge University Press

## Appendix A – The Big Picture or a Safety Management System Model

### The Big Picture - A Safety Management System



## Appendix B – The Misfortune Murphy Model

I hope that this hasn't overloaded or confused you. Please feel free to contact us at any time.

Please visit our website at [www.system-safety.com](http://www.system-safety.com). It has a lot of information that may be of value to you. You have our permission to use what is of use to you. We would be pleased to make a PowerPoint presentation to clarify and provide more detail re this model. We can do this for costs only as we are a very small organization.

Once more thank you for this opportunity.

Yours sincerely

Gordon Dupont CEO, Renee Dupont-Adam, President  
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Father and daughter of the Dirty Dozen

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Our Mission

To assist our clients in developing the best possible Safety system to meet their needs