Being Predictive in a Reactive World

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The big push today is for safety to be more predictive instead of reactive, the theme of ISASI 2012 being one example. This is a noble and worthwhile effort. However, regulators and safety investigation organizations are reactive by nature, so it is not an easy task. ISASI members are the ones who generate this reaction, since investigations are reactions to events. This will not and should not change. However, given our current "predictive" capabilities, and even more, given the reactive world we work in – particularly the safety world - is being predictive a realistic goal? This really raises two primary questions: 1. Can we be predictive? and; 2. Would prediction be successful in reducing risk? We will attempt to answer those questions later. As some background to answering them, let's step back to the very basics of safety and safety 101.

Safety is risk management. You can talk about SMS, ATOS, GASP, TEM, IOSA, CAST, etc. – but safety comes down to this one very basic concept – you need to eliminate, reduce, or acknowledge the risks you face. The first (and most difficult) step in any listing of risk management procedures is identifying hazards. If you don't know them, it is difficult to address them and thus to reduce risk. To identify hazards, you need data – accident data, incident data, and other data. In addition, we not only want to just reduce risk, but we would like to reduce risk in the highest risk areas. It would be good to prevent one accident every 10 years, but even better to prevent 10 accidents every year. We have data that show us what the high risk areas are. Figure 1 is the annual Boeing accident summary for 2002-2011. You don't need to be a trained analyst to look at this chart and determine what the high risk areas are. So safety is essentially one thing - managing risk, and the key to managing risk is utilizing data to identify the

hazards. All safety professionals know that risk equals probability times severity. We also know that everything in life has risk. Managing that risk is called safety. So, how do we manage risk? Well, you modify the probability or you modify the severity of a hazard. For example, for runway excursion risk, you can modify the severity by installing an EMAS bed at the end of a runway. This does not affect the probability of a runway excursion, but it does reduce the severity, and thus the overall risk of a runway excursion. Likewise, you can establish stabilized approach criteria and have a no fault go around policy. These will reduce the probability of a runway excursion, and again the risk. However, these will not affect the severity if an excursion occurs. Now some organizations operate in higher risk environments than others – i.e. they are high risk organizations. In other words, in their risk calculations, severity is a large number. Due to the type of operations, and particularly the consequences of risk management failures, some organizations operate in high risk environments and risk management is not just important, it is critical. Examples of this type of organization are the nuclear industry, the oil and gas industry, the chemical industry, medical, and, of course, aviation. It turns out that these organizations have some common elements they use in managing risk successfully. These elements include; good procedures that are written, well developed, and kept current; investigation of risk management failures with the goal of preventing them from happening again; sharing of information on risk management successes and failures; being proactive when addressing risk; and utilizing data in their risk management efforts.

Let me provide definitions for some of the terms that have been used that will be helpful as we continue: ***Reactive*** – wait until an accident happens, then address the risks; ***Proactive*** – do something before an accident happens by utilizing history, data, etc. Safety has a well earned reputation for being a leader in risk management because of its proven ability to be proactive; **Predictive** – do something based on potential risk to avert an accident that has not happened (yet). Figure 2 depicts a scale of how these definitions might be viewed with reactive at one end of the spectrum and predictive at the other. Prediction is really not difficult when talking about the major risk areas identified earlier. For instance, we can all predict 90 percent of next year's major accidents. 50 % will be approach and landing accidents, and half of those will be runway excursion accidents. There will be at least two turbojet and four turboprop CFIT accidents, and there will be one or two upset aircraft accidents. A small percent of the accidents each year are what is now called "black swan" events. These are events that, by definition, cannot be predicted. These include accidents like TWA-800, QF-32, and BA-038. We may never be able to predict events like these, but perhaps we can predict other critical areas to reduce risk.

This brings us back to the two questions posed earlier: 1. Can we be predictive?; and 2. Will it reduce risk? The answer to both of these questions is based on one thing – data. All our risk management efforts today are based on data. If you don't have data, it is unlikely you can get support for any risk reduction effort. That is why the Flight Safety Foundation's ALAR and CFIT efforts were successful in the 1990's – they replaced a lot of qualitative ideas with quantitative facts, all based on data. Now the data we use can be from an accident investigation (i.e. reactive) or from a data study of previous accidents or incidents (i.e.) proactive, or from potential events that haven't even happened (i.e.) predictive. One word of caution about data, particularly in today's digital world. It is possible to have too much data. There are organizations that get so much data that just managing it on a day to day basis takes all their time, energy, and expertise, and the real value of the data is never fully exploited.

So back to the question of can we be predictive. The answer to this depends on what you want to predict. At this time, it is unlikely that being predictive will discover some new, unknown high risk area and prevent a "black swan" event. It is doubtful we will identify some new high risk area like CFIT or LOC by prediction – we have already identified the high risk areas. However, by using today's data collection and analysis capabilities, prediction may enable us to look deeper into the already identified high risk areas to gain more insight into how effective our risk reduction efforts are, and perhaps identify risk reduction gaps we have missed. So can we be predictive – yes.

Now to answer the question "will being predictive reduce risk?" I think the answer to this is again yes. Our wealth of data today enables us to not only look at past accidents and incidents, but to also see what is happening in normal day to day operations, and to identify what the trends are. This is where the real benefit of prediction will be found – using data to look at trends that point to things that have not happened yet. Data enables us to look at the known high risk areas and "predict" where we might look to reduce the risk even more--- and without having an accident. Some examples are shown in the work ASIAS has done in identifying areas of multiple TAWS alerts, TCAS hot spots, and highlighting runway excursion risks before an excursion accident happens.

All this leads us to our reactive world and what support predictive efforts will get, i.e. what decision makers will do. This is probably our biggest challenge when it comes to making prediction successful. Just because we can predict does not mean prediction will be successful in reducing risk. Decision makers, particularly bureaucratic decision makers, are reactive by nature. The only way we can hope to influence them is by going back to the basics of risk management. We need to be able to show the risk, and show the ability to reduce the risk by addressing the probability or the severity. The

only way we will be able to do that is with data. However, we must realize that even with data it may be difficult to get decision maker support due to the reactive nature of the system. Sometimes support is hard to get even when being reactive. For example, let's say we could have predicted TWA-800. What would have been the result? Remember, it has taken 15 years to start seeing the risk reduction actions identified in that accident, and this was not a predicted risk, this event happened ! We knew that CFIT was the leading killer in the 90's, yet it took the Cali accident to make TAWS mandatory – and then only 7 years after the accident happened ! The fact is, even being reactive has sometimes been difficult – or at best very slow.

There are two keys to being predictive in a reactive world: 1. Have the data to verify the risk and show it is worth addressing, and ; 2. Have the support of the decision makers. The key to both of these is data. Data will enable us to use our predictive capabilities to further reduce risk. Decision makers, this includes individuals and the safety and regulatory systems themselves, are reactive by nature. However, with today's data capabilities we can hopefully use prediction to generate a risk reduction action ***before*** an accident. Data will also allow us to address the age old safety dilemma: how do you prove that you prevented an accident from happening if it doesn't happen? By utilizing incident and normal operational data in our prediction process we will be able to show that we reduced the risk of an accident and hopefully avoid having to react to one.