Comprehensive Risk Assessment: Solution for Management Insomnia

Larry I. Perkinson, CSP, ARM

The topic I bring to you today, Aligning Safety and Health Objectives for Leadership in Your Organization, was born out of what I am seeing in a number of the clients that I work with. I have had the opportunity to use the Occupational Safety and Health Assessment System (or OHSAS 18001) with several of my clients. OHSAS 18001 is what many believe to be the precursor to a new ISO standard on safety management. One of the most important aspects of OHSAS 18001 refers to the creation of a comprehensive risk assessment for the organization. There are at least two dozen or so other questions directly tied to the completion of the risk assessment and setting organizational objectives.

What I see in many of my client organizations is that, first, very few are performing a comprehensive risk assessment. There are generally only pieces of a risk assessment that has been performed. These companies learn from their own experience and accident records and others' experience what sorts of things have happened in the past; some have inventories of materials, equipment, energy sources, occupations and tasks; many have long lists of regulatory inspection items they review often and with which they attempt to remain in compliance. And yet there is not the common thread that weaves through all this to bring it together into one comparative piece.

Since we are going to be looking at all of this in light of, not only safety objectives, but the business objectives of our organization, there is something that would be good for us to remember. Peter Drucker, a management consultant and prolific writer on management, said, "The duty of business is to survive, and the guiding principle of business economics is not the maximization of profit – it is the avoidance of loss".

At this point I think we must revisit what the business of safety is, what are the "overarching goals that attach themselves to our profession", as Fred Manuele puts it (Manuele 11). According to Mr. Manuele, safety professionals exist only for the following:

- To anticipate, identify and evaluate hazards
- To give advice on the avoidance, elimination, or control of hazards to attain a state for which the risks are judged to be acceptable

Now I have always been of the opinion that it is the duty of management to know what risks are involved with the operation of their facility, and it is our duty as safety professionals to help them. We need to be helping our companies survive. We do it by identifying and mitigating risks that produce loss. And we need to let them know what all the risks are that we can find, and help them develop objectives that address those risks.

The other thing that I saw with my clients was that, even though they may have had safety and health objectives for their facilities that addressed certain risks they had identified, there was a major disconnect between the safety and health objectives for the organization and the safety and health objectives for line management. I saw some very appropriate objectives for mitigating certain risks at the organizational level. But the objectives for line managers were almost completely devoid of anything having to do with those objectives. Most line manager objectives had to do with achieving frequency rates in groups of employees that were not even large enough for their results to be statistically meaningful in a single year, much less in a given month. Also, there were no defined, written action plans for accomplishing the organizational level goals that required the participation of operating management.

The following goals will be addressed by this presentation:

- How to perform a comprehensive risk assessment in your organization, and tools to assist you in accomplishing this and how to use them
- How to use the risk assessment to link safety objectives and measurements with the objectives of line management

So what do we expect to get out of a comprehensive risk assessment? If we implement the process in the format that we are going to discuss, what are the "outputs" that management can expect to see for all the inputs they are going to make? Here are some of the deliverables that a good comprehensive risk assessment should provide:

- A reasoned analysis of all the identified risks at the facility and a prioritization of those risks when compared with one another.
- Action plans on reducing unacceptable risks, and on reducing the total sum of the risk at the facility/location.
- With the inclusion of the costs of the action plans to reduce risk, "What If…" strategies can be reviewed to find the most cost efficient way to reduce risk in the facility to acceptable levels.
- An integrated safety and health plan for the facility that cascades into the objectives of almost every operating manager at the site.
- A quantifiable measurement system that is tied directly to safety and health objectives/action plans and does not have to rely on accident frequency statistics to know when things are starting to go askew; it provides measures of safety performance for almost all operational management personnel
- Every level of operational management involved in the safety and health process
- Compliance with the intents and purposes of OHSAS 18001

Obviously, we can't expect to achieve any of this without the strong support of senior management at the facility. It is crucial that they understand the inputs and resources required,

what their participation is likely to entail, how the safety system is likely to change, and especially the benefits we described above.

We will begin with the comprehensive risk assessment. I think it would be a good start to begin with a list of things that normally would be good resources for us in generating a risk assessment. Ask what sorts of information exists that we already have access to that would provide a clue to the possible risks involved with doing business at our facility?

This list should include such items as:

- Facility asset inventory
- Process flow diagrams
- Chemical/waste materials inventory (e.g. HAZCOM and RCRA lists)
- Confined spaces inventory
- Lockout/Tagout inventory of equipment and energy sources
- Accident/Incident investigations
- Findings from internal hazard inspections performed
- Findings from external audits/inspections
- Description of risks found in industry trade group materials/information
- Claims data and information from insurance carriers/brokers
- Site visit surveys/reports from insurance carriers, brokers, and independent consultants, including safety, environmental, and industrial hygiene
- Inventory of hand tools and equipment
- Inventory of mobile and material handling equipment
- International, federal, state, local and trade group, or corporate regulations and/or consensus standards
- Facility occupation and task inventories
- Equipment manufacturer diagrams, descriptions, warnings and other written materials
- Building and equipment plans, blueprints, etc.
- Maintenance records and systems
- Records of employee/union complaints/suggestions

There is obviously some overlap between this large group of widely ranging sources. But there are very likely at least some things in each source that you will not find in other sources. All of this information it is possible to gather should be prepared and made available for the next step in the process. Information that identifies unusual/non-routine work, high energies, and non-production activities are especially important as studies indicate these activities result in high severity incidents.

The risk assessment itself is most likely going to have to occur on two different levels – a macro level and a micro level. The first assessment, at the macro level, will determine the processes, buildings, machinery or other facility groupings or designations that will receive high priority for an assessment in more detail. In this way, the processes that have the greatest potential for injury, damage, loss to building/environment/production etc. will be reviewed first.

The first thing to do for the macro assessment is to categorize the facility using some method that is logical for the organization. Most often organizations will divide the facility based on function,

process, or management responsibility. The macro assessment can be conducted by individual cross functional teams for each category, or it can be produced by a single cross functional team for the entire facility.

A cross functional team is one made up of a number of disciplines that would have the desired experience and expertise to make a contribution to the assessment. For example, a cross functional team might include the following departments or disciplines:

- Production operations and/or supervision
- Maintenance operations and/or supervision
- Engineering
- Environmental/Health/Safety
- Accounting/finance
- Purchasing/warehousing/shipping
- Quality/laboratory
- Specialized union representation

All of these may not serve on every team, and there may be teams where it makes sense to add additional expertise. However, since the assessment is going to be used to largely determine the safety and health objectives of the facility, it only makes sense to have representatives on the team from the functional areas of the facility that are going to be impacted by those objectives. There also may be some personnel that serve on more than one team if there are multiple teams. For a large facility (large number of individual processes or large number of employees, or both) it is more effective to have more than one assessment team.

It is important at this point that everyone serving on the assessment team(s) receive training on:

- The responsibilities of the assessment team(s)
- The goals of the risk assessment and the outputs that are expected
- The resources the team(s) will have available and how to access them
- Using the risk assessment tools provided and how to apply them
- Some basics in the development and deployment of proactive measurement strategies
- How data and action plans will be used, tracked and recorded.
- How objectives will be developed and cascaded through the organization

All of the resources mentioned earlier would need to be made available to the team/teams. If there is more than one team that is used to complete the assessment, there should be a Primary Team that is assigned the general oversight of the assessment process. This team will be responsible for reviewing the work of the other teams to ensure quality and consistency in the assessment and for making final judgments on recommendations to be made to management regarding objectives and action plans that come out of the assessment.

The team(s) will make an initial review for each category/process/department (depending on how the team(s) broke down the facility). The primary team (if more than one) will then take this initial data and generate priorities for more detailed reviews.

At this point it would be good to begin to take a look at the risk assessment tool we are going to be using for demonstration purposes (see Exhibit 1 – Risk Assessment Matrix). This is certainly not the only tool available and this is certainly not the only process. If you have access to others that seem to fit your organization or goals better, then by all means use them. Tolbert tells us "The variables that influence risk acceptability…are as numerous as the situations in which they exist" (Tolbert 27). Also, it is important that the Team(s) not place too much emphasis on historical data. Studies indicate that frequency does not necessarily predict severity. Using risk assessment tools that quantify potential severity can be a great tool in limiting potential severity.

The top of the page is meant for general information. Enter the company or operating location. For the purposes of example, we are going to be looking at a fictional molding operation that prepares molds for a foundry. We have entered, "Dallas Plant" on this line.

On the next line, "Risk Assessment for:", enter either the process, building, department, or whatever other large segment or category is being evaluated. In our example we are looking at the very general operations in the mold shop. This is the initial evaluation that the primary assessment team will use to determine where to drill down further.

Company & Operating Location: Dallas Plant
Risk Assessment for: Mold Shop
Date: 1/27/2006

Job/Task or Process/ System	Regulatory Issues	Risk Determinants						Risk Tolerance Criteria			
		Frequency of Loss Exposure	Frequency of Loss Event	Probability of Loss Event	Severity of Injury	Control Measures	Deviation from Controls	Initial Level of Risk	Adjusted Risk Score	Risk Tolerance	Risk Criteria & Action
Molding Machines	1910.212	4	2	3	3	1	2	9	2	Tolerable	Class I
Mold Preparation	1910.1000	4	2	3	3	2	2	18	5	Moderate	Class II
Moving Materials	1910.178	4	3	4	2	3	3	24	12	Intolerable	Class IV
				0				0	NA	NA	NA

Exhibit 1. This is the Risk Assessment Matrix.

The last line for this part of the form is the date of the evaluation. Since this is a general evaluation of operations, in the Job/Task or Process/System column, we have entered three general processes or tasks that are performed in the shop. The first is the use of molding machines. The column to the immediate right is for entry of any regulations that might impact the process. In this case, 1910.212, which is the OSHA reference for machine guarding, is entered.

Now we move into the portion of the form marked, "Risk Determinants". The first thing we want to do in the actual risk determination is to find out the probability that the risk will result in a loss. Probability is made up of two components: the frequency with which employees or processes are exposed to the risk; how often the loss exposure has occurred in the past. When we multiply

these two together, we get an idea of the probability that the loss will occur in the operation being evaluated. The ideal for determining probability would be to determine how many times the task or process is performed, what the loss incident rate is (how many times can we perform the task before we have a loss), then calculate the exact number of losses we can expect from our operation. Of course we rarely have this kind of information and we are relegated to using the categories of estimates we have here.

The first column is "Frequency of Loss Exposure", which refers to how often an employee or process is exposed to the hazard. In this case, for example, it refers to how often employees operate the molding machine. The "Frequency of Loss Exposure" is divided into four categories, numbered 1-4. The categories are:

- Very Likely to Occur [4]: Frequent exposure to hazard; contact with hazard occurs more than once per regular work shift or has occurred at that frequency in nearly identical operations company-wide
- Likely to Occur [3]: Occasional exposure to hazard; contact with hazard occurs at predictable intervals (such as at least once per regular work shift, week, month, etc.) or each time the special task is performed; expected but periodic exposure to hazard; has occurred in similar operations world-wide.
- Unlikely to Occur [2]: Limited exposure to hazard; contact with hazard during routine task or special task performance would be unusual, but could reasonably be expected to occur at some future time in the lifetime of the task.
- Highly Unlikely to Occur [1]: Typically never occurs although contact with hazard is possible. Has happened extremely seldom or not at all, even worldwide.

We have chosen the "Very Likely to Occur" category, and have entered the number "4" into the "Frequency of Exposure" cell, as employees operate the molding machine many times per shift. It is important to note here that you can modify any of these categories, as far as definitions, however you think would be most appropriate for your operations. Obviously you can change the numbers, too, but you would need to understand how the numbers worked in the spreadsheet to produce the "Initial Level of Risk" and the "Adjusted Risk Score".

The next column, "Frequency of Loss Event", is an estimate of the frequency with which the loss occurs. This information is usually obtained from historical precedent, either from within or from outside the organization being evaluated. Here are the categories for this risk determinant:

- Very Likely to Occur [4]: Loss event has been known to occur regularly at moderate to high frequency exposures
- Likely to Occur [3]: Loss event has been known to occur at periodic intervals at moderate to high frequency exposures
- Unlikely to Occur [2]: Loss event is rare, even at moderate to high frequency exposures, but could reasonably be expected to occur at some future time in the lifetime of the task.

- Highly Unlikely to Occur [1]: The loss event is not possible or has not been known to occur worldwide, even at moderate to high frequency exposures.

In our example, it has been rare for the molding machines to produce an injury. Therefore, we enter a value of "2" for "Unlikely to Occur". The values entered under "Frequency of Loss Exposure" and "Frequency of Loss Event" are used to calculate the "Probability of Loss Event", which is displayed in the next column. The categories for "Probability of Loss Event" are:

- Frequent to Probable [4]: The loss event is highly likely or almost certain to occur
- Occasional [3]: The loss event is likely to occur.
- Remote [2]: The loss event is unlikely to occur.
- Improbable to Impossible [1]: It is extremely unlikely or impossible for the loss event to occur.

In the case of our example, the high frequency of exposure (3) and the medium to low frequency of the loss event (2) produce a probability of "3" – the loss event is likely to occur at some point. Note again that the "Probability of Loss Event" column is calculated – we did not enter a value into that column.

Now we move to the next column, "Severity of Injury". The choices in this column are listed below:

- Severe [4]:
    - Injuries & Illnesses: Death or seriously debilitating long-term injury/illness, such as multiple amputations, coma, or permanent confinement;
    - Industrial Hygiene: exposure to substance which is Immediately Dangerous to Life and Health (IDLH);
    - Loss (Includes events such as Fires and/or Explosions or other perils from nature): Structural damage to building or property, loss of production and/or major damage to processes or process area, facilities or utilities.
- Serious [3]:
    - Injuries & Illnesses: Permanent or nonreversible injury/illness significantly impacting the enjoyment of life, and which may require continued medical treatment (LWDC, SIIC or other injury/illness that will result in permanent job restrictions);
    - Industrial Hygiene: Exposure above action limit with the potential for injury in this classification.
    - Loss (Includes events such as Fires and/or Explosions or other perils from nature): Stoppage of production for more than 24-hours, and/or damage to process area.
- Significant [2]:
    · Injuries & Illnesses: Permanent and nonreversible minor injury that does not significantly impact upon the enjoyment of life, or a reversible injury, either of which requires medical treatment (Recordable injuries/illness, or cases that result in a temporary job restriction);
    · Industrial Hygiene: Any exposure above the action limit.
    · Loss (Includes events such as Fires and/or Explosions or other perils from nature): Stoppage: Loss of production of less than 24-hours and/or damage to process area; Potential of fire in the incipient stage where chemicals such as volatile organic

compounds (solvents) or other incendiary materials such as combustible metals are used or stored in a waste form, or the temporary evacuation of plant personnel.

- Minor [1]:
  – Injuries & Illnesses: Reversible injury requiring only simple medical treatment with no confinement (First aid cases);
  – Industrial Hygiene: <0.5 x OEL or < 0.1 x OEL for carcinogens;
  – Loss (Includes events such as Fires and/or Explosions or other perils from nature): No loss of production and/or damage to process area; Potential of fire in the incipient stage in a "non-production or non-storage area" that may be controlled through the use of a portable fire extinguisher or the temporary evacuation of location personnel.

Since the molding machines have the potential for a crushing injury or even amputation, we have entered the number, "4", in keeping with the definition, "Death or seriously debilitating long-term injury/illness, such as multiple amputations, coma, or permanent confinement".

Now we know what the probability and severity of the exposures are and have given them a numerical rating. The "Initial Level of Risk" column in the "Risk Tolerance Criteria" section, takes these factors, multiplies them, and produces a number, in this case, "9". Now, however, we get to take a look at the controls that we have already put in place to address these hazards and take some credit for them.

The "Control Measures" column provides a means for evaluating the level of protection that has been implemented for the hazard. The categories for this column are:

- None [4]: No control measures are in place.
- <75% In Place [3]: Personal Protective Equipment (PPE) is the primary method of protecting employee exposure. Work practices have been written or addressed in training; Administrative controls are not utilized; Engineering controls are not deployed.
- 76% to 99% In Place [2]: Administrative and Work Practice controls are utilized including the wearing of Personal Protective Equipment (PPE) and safe behavior observations are used to ensure compliance; Process and Engineering controls are deployed but not fully integrated into inspection or Preventive Maintenance (PM) systems or Engineering controls have been deemed not feasible.
- Complete [1]: Engineering controls, local exhaust ventilation, and/or the use of isolation technology is fully deployed, and operational to an acceptable level. As a "best practice," PPE may be used in addition to Engineering controls.

Since we have implemented two handed operational control buttons for the molding machine, the number "1" has been entered, indicating that engineering controls have been put into place. The last column in the "Risk Determinants" section, "Deviation from Controls", is an assessment of how difficult it is to bypass the controls that have been established, or assurance factors. Here are the categories of assurance factors:

- No Assurance [4] (Factor of .75): Control measures are not in place.
- Insufficient Assurance [3] (Factor of .50): Control measures are partially in place, but there is no assurance that will prevent controls from failing or being deviated from.

- Near Assurance [2] (Factor of .25): Administrative and Work Practice controls are utilized including the wearing of Personal Protective Equipment (PPE); Process and Engineering controls are deployed but not fully integrated into inspection or Preventive Maintenance (PM) systems or Engineering controls have been deemed not feasible.
- Attained Assurance Level [1] (Factor of .125): Select this level when mechanical control measures in place cannot be deviated from either inadvertently or intentionally, and when the "5-Basis Methods for Controlling Risks" are in place and operational. This would include controls such as, interlocks in place on all equipment where interlocks cannot be bypassed, and equipment/controls can not fail to an unsafe condition; inspection and PM systems are fully deployed. Select this level if a "safe behavior process" is fully implemented, and abeyance to safe work practices such as safety rules or Job Safety Analysis (JSA's) are a part of the observation process.

Note that the "Factor" in each category is multiplied by the "Initial Level of Risk" to yield the "Adjusted Risk Score".

In our example, we have chosen the number "2". This choice was made because it is possible under certain circumstances to bypass the controls, and the inspection and preventive maintenance system does not inspect/test/check the controls on a regular basis. However, the controls that are in place, while not perfect, have reduced the risk rating from an "Initial Level of Risk" equaling "9" to an "Adjusted Risk Score" of "2". The "Adjusted Risk Scores" correlate by number to the "Risk Tolerance", as indicated below:

- >12 - (Intolerable Risk)
- 8 - 11 - (Substantial Risk)
- 5 - 7 - (Moderate Risk)
- <= 4 - (Tolerable Risk)
- NA - Risk has not been evaluated.

The "Risk Tolerance" column/levels are described below with their "Action Classes" as:

- Intolerable Risk- Class IV
- Substantial Risk - Class III
- Moderate Risk - Class II
- Tolerable - Class I

The Action Classes denote what level of action the facility has determined they will take to alleviate a risk of a certain magnitude. The actions for our example facility are as follows:

- Class IV - Intolerable: Discontinue operation or do not start until risk has been reduced to the greatest extent feasible. Management and Facility Safety & Industrial Hygiene personnel must approve continued operation. Action plan must be in place to reduce risk to Class II or I. Risk control measures need to be based on primarily engineering controls with high reliability. For proposed work, do not start until risk has been reduced.
- Class III - Substantial: Corrective actions should be taken with urgency to reduce risk to Class II or I. Risk controls need to be based on sound engineering controls and may be

supplemented by administrative controls. For proposed work, do not start until risk has been reduced.

- Class II - Moderate: Initiate efforts to further reduce risk. Implement measures within short time period. Monitoring is required to ensure that available controls are maintained.
- Class I - Tolerable: No action or additional controls required.

Of course, these classes can be modified to reflect the risk and safety philosophy of the facility where the risk assessment is being performed. Our example shows an "Adjusted Risk Score" of "2", which is a tolerable risk and falls within the Class I action criteria (no action necessary).

The last example in the table involved material handling. While there is some forklift usage involved, hence the reference to 1910.178, there is also a good deal of manual material handling with this process. Since materials are lifted, carried, and moved multiple times per day, we have entered, again, a "Frequency of Exposure" equal to "4".

Since there have been numerous material handling injuries in the department, the "Frequency of Loss Event" is considered a "3" - Loss event has been known to occur at periodic intervals at moderate to high frequency exposures. This produces a "Probability of Loss Event" equal to "4" - Loss event has been known to occur at periodic intervals at moderate to high frequency exposures.

We will assume a "Severity of Injury" of only "2" - Injuries & Illnesses: Permanent and nonreversible minor injury that does not significantly impact upon the enjoyment of life, or a reversible injury, either of which requires medical treatment (Recordable injuries/illness, or cases that result in a temporary job restriction). The "Control Measures" that the facility has in place are minimal. Back belts were handed out, but there are no engineering controls, there have not been any work practices written or any training on proper ergonomic techniques. This produces a score of "3" - Personal Protective Equipment (PPE) is currently the only method of protecting employee exposure. Work practices have not been written or addressed in training; Administrative controls are not utilized; Engineering controls are not deployed.

The "Deviation from Controls" isn't any better and it has also been rated a "3". This results in an "Initial Risk Level" of "24", an "Adjusted Risk Score" of "12", which is an intolerable risk and carries a Class IV action level requirement. Simply because we have not developed procedures for manually moving materials, trained our employees in those procedures, or used a reinforcing mechanism for those behaviors, we have an intolerable risk.

Now that an initial review has been conducted at the department or process level, the Primary Assessment Team will review all the data and assist the departments or sub-teams in setting priorities for a more in-depth assessment. It is at this level where an individual task or machine/process will be reviewed in detail. Using our earlier examples for the Molding Department, it was obvious that manual material handling was a major issue and needed to be addressed.

An excellent resource for such detailed analyses is the inventory of tasks performed by each occupation, and, if available, the specific job procedures or JSA's if any have been written. Of course, in our example no such procedures existed, hence the high risk rating. However, use of

the first step of the JSA process (list the steps involved in accomplishing the task) would be one way to help assess the hazards in the task or process.

A method for evaluating each one of these steps is what I refer to as the "PEME" matrix – PEOPLE, EQUIPMENT, MATERIALS, and ENVIRONMENT.

- People – This variable involves determining what people are involved in the process (operational employees, maintenance employees, management, contractors, visitors, vendors, neighboring plants or the community) and what are the capabilities and limitations of those people (physical/physiological capacity; training and education; motivation; stress).
- Equipment – This variable includes machinery, tools, guards/interlocks, structures, vehicles, cranes, etc. and their condition.
- Materials – This variable includes chemicals, raw materials, process intermediates, finished product, oils/lubes, etc.
- Environment – This variable is a large one, and includes: the physical environment, such as temperature, humidity, noise, lighting, etc.; air contaminants present; the process layout; the condition of the area regarding housekeeping; the relationship of the process to the general environment and how it might affect water and air quality.

Variables	People	Equipment	Materials	Environment
People				
Equipment				
Materials				
Environment				

Exhibit 2. This is the PEME Matrix.

By putting these four variables in a matrix (see Figure 2 – PEME Matrix) and analyzing how they affect one another at their intersection, we get an idea of what hazards exist at each step of the task, or at the interfaces of the variables when looking at a process component. The following paragraphs review each of these interfaces and refer to specific data mentioned previously that can help with the evaluation of the specific variables.

1. People with People - What are the parameters for their interaction, such as communication mechanisms; does one perform a task that places the other at risk; what kinds of reinforcement exist (positive, negative, extinction, punishment) in their interactions; are there disparate experience, education or training levels that could lead to hazards; are the physical and cognitive demands shared appropriately to prevent overload; etc.
2. People and Equipment (energies involved from lockout/tagout inventory, confined spaces inventory/evaluation) - Here we want to look at how people interact with the tools, equipment, machinery, vehicles, etc. Are there interfaces that produce hazards, such as sharp edges, possible uncontrolled or accessible energy sources such as electrical, hydraulic, mechanical, etc., control panels or features that might pose human factors problems (such as sensory overload or control design), can the person by-pass safety structures or interlocks, is there a safe pattern for worker movement among machinery, vehicles, etc.
3. People and Materials (chemical inventories, purchasing records)- Is there any contact with materials that could prove toxic through inhalation, ingestion or absorption; could the

materials by virtue of their shape, size, mass, or other physical characteristics cause ergonomic problems (moving the material manually from one point to another) or direct injury (sharp edges, rough texture, etc.).

4. People and Environment – Are there attributes of the physical environment that could cause injury, such as heat, cold (including ice and snow), humidity, noise, radiation, air contaminants; is the process laid out in such as way as to cause hazards, such as traffic patterns, poor exit access, etc.; does the environment and/or production schedule produce housekeeping issues that pose hazards; could workers' interaction with the environment pose dangers to ambient air or water quality; etc.

5. Equipment and Equipment – Are vehicle traffic patterns controlled enough to prevent equipment collisions; are the interactions and interfaces between different machines well known and documented (anecdote); etc.

6. Equipment and Materials – Are the materials being used in the equipment compatible with the equipment; etc.

7. Equipment and Environment – Is the equipment being used compatible with the heat/cold/humidity and other variables of the environment; is the use of equipment conducive to the actual or designed layout; does the equipment produce housekeeping problems that could be a hazard; etc.

8. Materials and Materials – Are materials being used compatible with each other;

9. Materials and Environment – Are the materials being used compatible with the heat/cold/humidity and other variables of the environment; can materials enter or effect plant and external air and/or water quality; does the use of materials produce housekeeping problems that could be a hazard; etc.

10. Environment and Environment – are there environment attributes that interact to form hazards or make hazards worse (such as temperature and humidity); are there environment attributes that are inside the facility that can the environment outside the facility (such as noise, water/air contaminates, etc.); etc.

Using the PEME analysis on every step of a job or with every process or machine yields hazards that will go into the Job/Task or Process/System column. Each of these will be evaluated using the process discussed earlier.

Another useful tool as you look at the interactions between the various systems is a list of, what some insurance companies refer to as, causes. While they are not really causes, they do describe injury mechanisms that can help visualize how various systems might interact together to produce an injury.

Whether you use this system, or some other system that is either more or less complex, to arrive at what the risks are for your facility, once you have identified the risks and prioritized them, you have to determine what you are going to do about them. The spreadsheet provides an excellent tool to perform "What If…" analysis. In other words, if we did this or that, how would it affect the risk rating? In our manual materials handling example, if manual material handling aids, such as small hoists or Intelligent Assist Devices (IAD), were used, we might be able to reduce both the frequency exposure and loss exposure numbers down by "1". This would also reduce the "Control Measures" score to "2". In that case our actions would reduce the "Adjusted Risk Score" to "4", and the "Risk Tolerance" to tolerable – which reduces the "Action" to Class I – Tolerable.

We could also develop specific material handling procedures, train our personnel in those procedures, and require supervisors to perform and record a daily observation of the procedures. In this case, while the exposure numbers would remain the same, the scores for "Control Measures" and "Deviation from Controls" could both drop from "3" to "2", again reducing the risk to tolerable and the action to Class I.

The first part of the work has been done. The Assessment Team(s) have identified risks in the facility, classified and prioritized those risks, and selected risks for mitigation. At this point, recommended action plans for addressing the selected risks should be developed by the Team(s) with the assistance of safety and health personnel and the owners of the risks (personnel responsible for the department or processes where the risk exists). The "What If…" analysis referred to earlier will help with arriving at action plans that are cost effective. When the action plans have been completed, they will be submitted first to the Primary Team. It will be their job to determine if the risk assessment tools were used correctly, and to be sure that action plans/items in one area or department don't conflict with or adversely impact those in another area or department. The will also consider whether reducing total risk can be achieved more effectively with less resources. After review, they will forward their final recommendations to senior management for approval, timelines and funding.

Now, armed with the information from the risk assessment and the action plans that were developed to address the risks selected for mitigation, the action plans must find there way into the safety and health objectives of the organization. The Assessment Team(s) should work with the Safety and Health and Human Resource Departments and the operational managers and supervisors to cascade the action plan items to every level of operational management. One very important part of the action plans/items is the development of a measurement strategy for each plan and review mechanisms to ensure the plans/items stay on schedule.

This information can be captured on the Risk Assessment Action Planning Worksheet (see Exhibit 3 – Risk Assessment Action Planning Worksheet). The top of the form is used to record the name of the risk assessment sheet and the hazard from that sheet that the action plan is addressing, and the "Adjusted Risk Scores", "Risk Tolerance", and "Action Class" before and after implementation of the planned changes.

In the example on the attached sheet, we are reviewing the action plan for implementing written procedures and administrative controls in the mold preparation area of the Mold Shop manual material handling takes place. By implementing written procedures and administrative controls and by improving the assurance that controls will not be deviated from by implementing an observation process, we have reduced the risk to an acceptable level.

The first column records a number for each action item. In the second column, the detailed action to be taken is listed. In the next column, the Person Primarily Responsible (PPR) and their department is entered. The Target Date for the completion of the item is entered into the next column. The last

Risk Assessment Sheet: <u>Mold Shop</u>   Date of Assessment: _01/23/06_____

Identified Hazard and Assessment Sheet Line Number: _____9_____ Plan Target Date: _11/15/06_____

Current Adjusted Risk Score: ____12_____ Current Risk Tolerance: ___Intolerable__ Current Action Class: _____Class IV____

New Adjusted Risk Score: _____4_____ New Risk Tolerance: _____Tolerable____ New Action Class: ____Class I_____

No.	Action Item	PPR/Dept	Target Date	Measurement Type
1	Supervisors & EHS meet and write interim procedures. Train employees and implement.	Smith-Mold Reynolds-EHS	2/3/06	Date
2	Select and engage consultant to review manual material handling operations in the mold preparation area and make engineering, procedural and administrative control recommendations	Reynolds-EHS	3/1/06	Date
3	Consultant completes on-site visit.	Reynolds-EHS	3/15/06	Date
4	Receive consultant report.	Reynolds-EHS	3/30/06	Date
5	Using consultant report, develop written work procedures for manual material handling tasks. Provide the procedures to EHS for review	Smith-Mold Shop	4/15/06	Date
6	Using report, develop job rotation or other administrative controls and integrate into procedures and production planning and provide to EHS for review. Develop RFA for engineering controls.	Smith-Mold Shop	5/1/06	Date
7	Review and return controls and procedures to Mold Shop with recommended changes.	Reynolds-EHS	5/15/06	Date
8	Make final changes to controls and procedures.	Smith-Mold Shop	6/1/06	Date

9	Work with EHS to develop observation checklist based on controls and procedures	Reynolds/Smith Mold Shop/EHS	6/15/0 6	Date
10	Develop and deliver training on controls and procedures to all shop personnel (operators, supervisors, and managers)	Smith-Mold Shop	7/1/06	Date Audit
11	Train all supervisors and managers on how to make and record observations using checklists. Checklists are to be completed at least weekly by each supervisor.	Reynolds-EHS	7/1/06	Date Audit
12	Implement procedures, administrative controls and observations	Smith-Mold Shop	7/15/0 6	Date Audit
13	Complete installation of engineering controls	Smith-Mold Shop	9/1/06	Date

Item No.	Measurement	Period	PPR/Dept	Distribution
11	Review training records to determine that all current/new/transferred employees in the mold shop received procedures and control training prior to beginning work under the controls/procedures	Semi-Annually	Smith-Mold Shop	All Mold Shop Mgmt; EHS; Plant Manager
12	Review training records to determine that all current/new/transferred supervisors and managers in the mold shop received observation training	Semi-Annually	Smith-Mold Shop	All Mold Shop Mgmt; EHS; Plant Manager
13	Review observation sheets turned in. Count sheets and compare to the number of sheets that should have been turned in for the period.	Monthly	Smith-Mold Shop	All Mold Shop Mgmt; EHS; Plant Manager
13	Interview at least two employees on each crew. Ask if they have received any observations from their supervisor. If so, ask how the observation was conducted and what feedback was provided by the supervisor.	Quarterly	Smith-Mold Shop	All Mold Shop Mgmt; EHS; Plant Manager

11 12 13	Perform all the above	Annually	Reynolds-EHS	All operating management from Department Manager and higher

Plan Closing Date:_____ Closed By:_____

By my signature closing this action plan, I certify that all the action items listed have been completed. In addition, I have reviewed the action items in place and certify that:

1. The problem the action plan was created to address was fully resolved.
2. The actions taken did not create new hazards.
3. The residual risk was considered and is deemed to be acceptable.

Exhibit 3. This is the Risk Assessment Action Planning Worksheet.

column is for the Measurement Type. In other words, how are we going to measure the completion of this objective and what it was intended to do. There are two types of entries for this column: date or audit. Most of the Measurement Type entries (in the example, action items 1-9) will be the Date type. This means that the only way we plan on measuring this action item is whether or not it was completed by the target date. However, it is important for some items to have additional measurements attached that will be audited on a periodic basis. These are assigned the Audit type. All of the items assigned the audit type are then listed in the next part of the sheet, the Audit Measurement Strategies portion.

The first column lists the action item number from the chart above. In our example, there were three action items, numbers 10-12, that have Audit entered into the Measurement Type column. Each of these is addressed in the Audit Measurement Strategies table.

The next column lists the specific measurement strategy for the action item. If we consider the action item that all personnel in the mold shop receive the training (Action Item 10) , this is obviously a crucial task to lowering the risk score. It is important that we receive some assurance that this training has taken place. However, since there is almost always turnover in a facility/department, it is important that new or transferred employees coming into the shop receive the training prior to beginning work. If this does not take place, then the risk score would be valid only as long as no new personnel come into the department. To maintain the risk score at the projected level, the facility needs to be sure that all new and transferred employees coming into the department receive the training.

The next two columns show the frequency with which the measurement is to made and the person responsible for making the measurement. The last column shows the distribution of the completed measurement.

It is important here to consider the points made by a couple of the other measurements in this example. The training required for supervisors and managers in item 11 is very similar to the item listed above. However, Action Item 12 requires something a little different. In order to get the assurance level on the controls that we need, a system was implemented to observe employees regularly and make sure the new procedures and controls were being used. In order to keep the assurance level, these observations must take place at the schedule frequency. The measurement strategies for this item require a review of the number of sheets turned in against the number that should have been completed. This will be done on a monthly basis by one of the managers in the shop. In addition, to be sure that the checklists are not being "pencil whipped" (filled out in the office without actually performing an observation), employees are interviewed on a quarterly basis to find out if they are actually being observed by their supervisors using the checklists.

Finally, in order to get an unbiased view of all these measurements, on an annual basis the Safety and Health Department will perform an audit or they will obtain the services of a consultant to perform an audit of these and other such processes in the facility.

Two very important items at the end of the Action Planning Worksheet are the Closing Date and the signature of the person authorizing the closing. It is imperative that the action plans/items implemented have the intended effect on the hazard. It is necessary to ascertain if the hazard has been fully, or only partially resolved, that during the process of plan implementation we didn't uncover additional hazards that need to be addressed, and that the action plans/items didn't result in new

hazards that were not foreseen. By dating and signing the closure line, the closing manager is assuring that she/he has considered these issues and finds everything to be satisfactory.

Once all the action plans have been completed, it is important for the operating managers to use the action plans for their respective areas of responsibility to develop activity-related goals and objectives for every supervisor and middle manager in their organization. *Each one of these supervisors and managers should have responsibilities for completing some portion of the action plans and/or for taking and reporting key measurements on plan implementation.*

As an example, while on the Action Planning Worksheet, Ms. Reynolds is listed as the responsible person for all the action items for the mold preparation area, she is responsible for seeing that they get done, not necessarily for doing them. It is the responsibility of her or her manager to dole out parts of the plan to other supervisors/managers in the department and incorporate those activities into their performance measurement/appraisal.

In our measurement strategies, it is made clear that periodic training must take place, observations must be performed and checklists filled out every week. Making and recording 80-100% of the required observations should be included in the performance objectives for every supervisor in the department. Providing the training prior to the assignment of new or transferred employees should be in the objectives for the manager/supervisor responsible for providing the training.

Each one of these measurements should cascade back upward into the performance reviews/objectives of the managers who supervise these employees all the way to senior management. Using these techniques, we measure our management team as much or more on what they are doing to reduce risk and the resulting accidents and injuries than on injury frequency rates alone. If we have adequately identified risks and developed effective plans and measurements for their control, injury severity will have to fall. I say injury severity and not frequency as studies are beginning to show that lowering frequency doesn't necessarily mean that severity is affected and vice versa.

The status on each plan and the respective action items should be reviewed on a regular basis by management, preferably no less than quarterly. A good way to do this is to have a regular staff meeting of the senior managers include this review at least once per quarter. If the Safety and Health Manager is not normally part of this group, he/she should attend this portion of this meeting. In addition, every manager/supervisor should have a mid-year review to discuss the status of their objectives and measurements so that any necessary changes or adjustments can be made to ensure objectives are completed by year end.

Each manager attending the session will review and prepare to discuss the status of all action plans/items under their jurisdiction. All measurement data should be reviewed, along with accident investigation reports, hazard inspection reports, etc. These might assist with tweaking the action plans/items. This senior management group will make decisions about extending target dates, making changes to action plan items, etc. These meetings, the plans reviewed and the decisions made should be well documented.

This same management group should hold an annual meeting that reviews all the measurements and progress made during the year. In addition, the group should consider accident statistics, internal and external management system audits, results of emergencies or emergency drills, along with the results

of hazard identification, risk assessment and risk control processes to set a course and determine objectives for the following year.

Finally, there should be a system and procedures in place that requires this same risk assessment process to be used any time a change is introduced into the workplace. The change could be installation of a new piece of equipment, a switch to a new raw material, use of a different production component, a reconfiguration of a control panel, or the introduction of a new work method. Review by the Safety and Health Department of any planned change would be a way of ensuring that the responsible department has completed the risk assessment process for the change. This, too, should be part of the annual audit performed by the Safety and Health Department or an outside consultant.
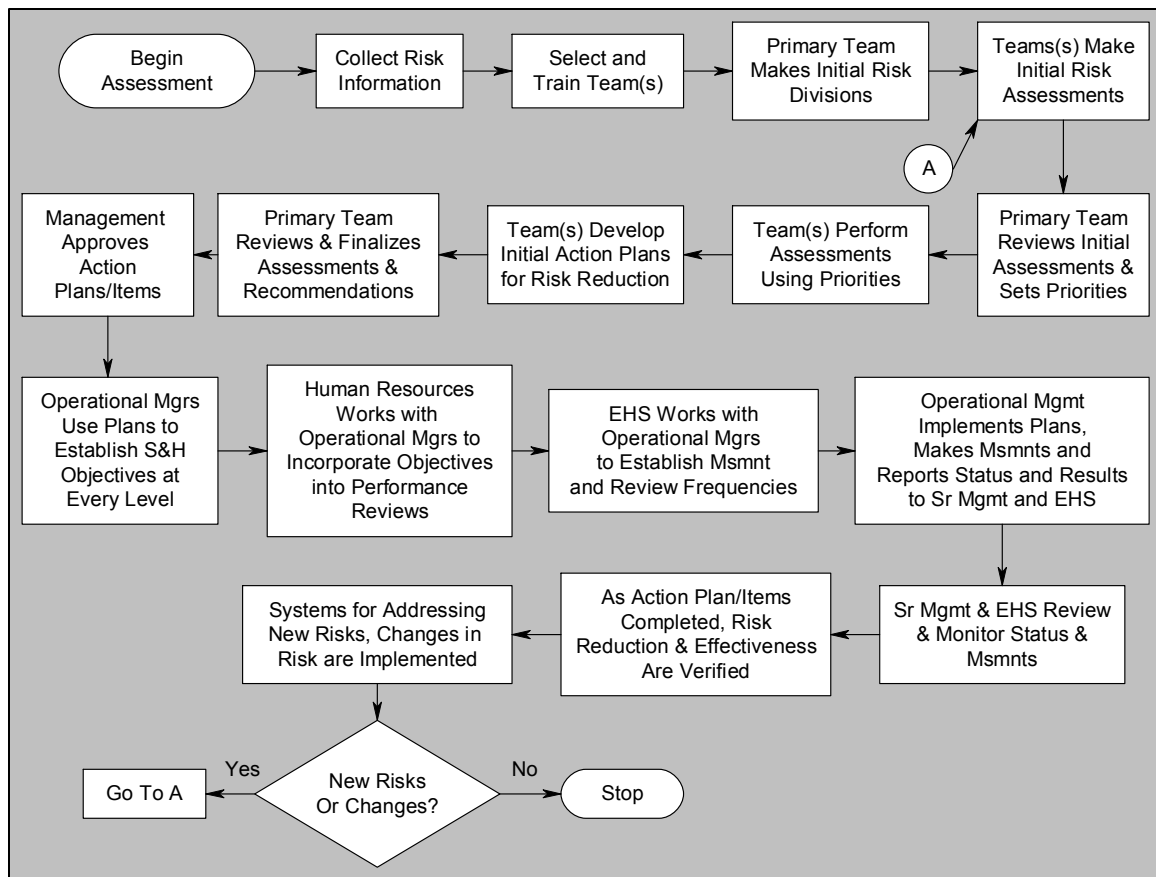

Exhibit 4. This is the Risk Assessment & Objectives Flowchart.

A flow chart (see Exhibit 4 – Risk Assessment & Objectives Flowchart) has been developed and included that provides an overall view of the risk assessment and objectives development and deployment processes.

The tools we have discussed have involved the process of identifying, classifying and prioritizing risks within our facilities or companies, then using the information to develop and align safety and health objectives across the entire organization. This has included measurement strategies and

processes to ensure ongoing assessment of new hazards. The proper and continued use of these tools will ensure that safety and health processes become and remain a strategic part of operational goals.

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