AN INDUSTRY MONITORING SYSTEM AS A SAFETY MANAGEMENT TOOL[1]

Cesar F. do Nascimento[2]
Paulo F. F. Frutuoso e Melo[3]

Abstract
We want to demonstrate that a combination between a behavior-based monitoring process – an At Risk Behavior and Unsafe Condition Observation System – and a safety adherence monitoring process, based on an observation system that indicates the compliance level with well-defined and agreed safety critical aspects and operational practices and procedures, established on Safety Handbooks, shall work as an effective safety management tool for any industrial facility or construction site, in order to achieve a zero-zero accident/lost time injury goal. The safety management system described here represents a particular case, developed by White Martins Gases Industriais Ltda (WMGI) and has also originality characteristics since other safety surveillance systems usually adopted in industrial environments can rarely be used on construction sites as well, they also don't share information, knowledge and skill between the safety staff and other professionals invited for observations, and usually cover just specific tasks or specific professionals, not a complete working area, which causes functional observing and monitoring limitation in terms of behaviors and environmental safety issues to be captured. It offers a wide range of learning opportunities and continuous improvement for any kind of industrial or construction enterprise.
Key words: Safety; Management tool; At risk behavior.

SISTEMA DE MONITORAÇÃO DE UNIDADES INDUSTRIAIS COMO FERRAMENTA DE GESTÃO DE SEGURANÇA

Resumo
Queremos demonstrar que a combinação entre um processo de monitoração comportamental – um Sistema de Observação de Comportamentos de Risco e Condições Inseguras – e um processo de monitoração de aderência de segurança, baseado num sistema de observação que indique o nível de conformidade com aspectos críticos de segurança, práticas operacionais e procedimentos bem definidos e acordados, estabelecidos em Manuais de Segurança, deve funcionar como uma efetiva ferramenta de gerenciamento de segurança para qualquer unidade industrial, ou canteiro de obra, de forma a se atingir a meta de zero-zero de acidentes/perda de tempo de trabalho. O sistema de gerenciamento de segurança descrito aqui representa um caso particular, desenvolvido pela White Martins Gases Industriais Ltda. (WMGI) e tem ainda características de originalidade, já que outros sistemas de supervisão de segurança usualmente adotados em ambientes industriais raramente podem ser utilizados em canteiros de obras, usualmente não partilham informações, conhecimento e habilidade técnica entre o time de segurança e outros profissionais convidados para observações, além de normalmente cobrirem apenas atividades específicas ou profissionais específicos, e não uma área de trabalho completa, o que promove apenas observação funcional e limitações de monitoração, em termos de questões de segurança comportamental e do ambiente de trabalho monitorado. Ele oferece um grande alcance de oportunidades de aprendizado e de melhoria contínua para qualquer tipo de indústria ou empreendimento de construção.
Palavras-chave: Segurança; Ferramenta de gestão; Comportamento de risco.

[1] *Contribuição técnica ao 23° Encontro de Produtores e Consumidores de Gases Industriais, 13 a 15 de agosto de 2008, Porto Seguro, BA*

[2] *Engineering Safety Consultant, Global Supply System, White Martins Gases Industriais Ltda. (Praxair Inc.)*

[3] *D. Sc., Nuclear Engineering Program, Alberto Luiz Coimbra Research and Post Graduation Institute, PEN/COPPE/UFRJ*

1 INTRODUCTION

From a practical standpoint we can say that incident and injury prevention is a fundamental feature for any industrial activity, and the penalty for neglecting or approaching it inadequately will be unnecessary human suffering and financial losses. Thus, the preventive objectives take human and economic issues into account, and the paths and methodologies adopted for this process have the skill to directly or indirectly influence personnel's attitude and, consequently, create organizational safety culture improvement.

Safety is not a product itself, but the result of all work processes in place for every activity, system, facility, or environment. The experience gathered on engineering safety indicates that incidents and injuries can be avoided. The development of theoretic knowledge and accumulated practice, specially since the beginning of the 20th century by Heinrich,(1) show that these events have common basic or root causes, and we can even say that they have the same common basic "mechanism", formed by the combination or interaction of an at risk behavior – defined here as any unnecessary unsafe action or hazard exposure – and unsafe conditions, that can be represented by any environmental potential hazard. This "mechanism", like any other, allows an objective and technical interference in its "structure" to avoid that incidental events take place. Therefore it's necessary to develop and use an objective and concrete prevention system for observing and anticipating the occurrence of risk behaviors and unsafe conditions, and promoting environmental monitoring about these fundamental safety aspects in order to guarantee the effectiveness of the safety management system in place.

2 MATERIALS AND METHODOLOGY

2.1 The WMGI/Praxair[1] Case

Although this safety management tool can be implemented in any industry or construction site, the system described here was originally developed and used in WMGI, in Praxair's GSS[2] group, which is responsible for two Brazilian mechanical factories[3] in Rio de Janeiro and handles all South American construction sites for White Martins/Praxair facilities.

Almost seven years ago (December/2000) this safety management tool was implemented at WMGI. There were three different phases, each one representing an important step to correctly configure this tool. The first was defining safety criteria and requirements that all employees and contractors working for WMGI/Praxair should be committed with. This was actually the most important phase because it represents the company's philosophy in terms of injury prevention, described by the safety key performance indicators (KPI's), and the approach the company put in practice to achieve these safety goals for the two working environments, construction and mechanical fabrication. This phase was completed with the edition and full implementation of the Safety Handbooks (Construction and

---

[1] White Martins Gases Industriais Ltda. is a Praxair Inc. subsidiary in Brazil, actuating on industrial gases (Oxygen, Nitrogen, Argon, Acetylene, Hydrogen, etc.) and LNG production and distribution, and also industrial and medical services.

[2] GSS is Praxair's Global Supply System group, which provides engineering and technical solutions for the Corporation worldwide.

[3] FEC stands for fabricating, maintaining, and field erecting the Cold Box – the air separation column – cryogenic tanks and vessels, and all production subsystems for Praxair industrial gases facilities worldwide, and also FATRAN, for truck and trailers fabrication and maintenance in South America.

Fabrication), regarding their specificities for each environment. The second phase covered the safety observation system implementation. Actually it was a behavior-based observation process with a focus on at risk behaviors and unsafe conditions at the working area, supporting and giving feedback for team supervision. The third phase, the most recent one, was regarding a safety adherence observation system, which has the capability to demonstrate all effort developed by employees and contractors to achieve safety goals, in terms of compliance with safety requirements established in the Handbooks. This phase was used to define a new safety process performance indicator (PPI) for the Company.

3 RESULTS AND DISCUSSION

For a better understanding of this safety management tool there is a description bellow of each implementation phase and the results obtained.

3.1 Phase One: KPI's and Safety Handbooks

The company's safety management system has specific goals to be achieved, named Key Performance Indicators (KPI's). Although they always mean failure, because they indicate incidents and injuries occurred in the work sites, they also establish a target to be aimed or a premium to the team effort. The safety KPI's shall not be subjective, but on the contrary, they need to be clearly known and understood as a possible number to be reached. As a worldwide corporation, Praxair establishes these KPI's on a global basis, but every world region shall work for its own results. They reflect regional major injury rates per 200,000 man-hours, on a monthly basis, which include recordable injury incidents (RII) – actually injuries classified as non-lost workday cases (NLWC) – and the lost workday cases (LWC).
Table 1 shows the Praxair/GSS recordable accident rates, considered KPI targets for three different Praxair/GSS working areas: Contractor expresses construction activities usually performed by third-part companies with Praxair team supervision; Engineering regards project design team at main office or visiting any factory or construction site; and Manufacturing collects major accident rates for FEC and FATRAN factories, including WMGI employees and contractors.

Table 1. Safety Key Performance Indicators (KPI's)

Working Areas	KPI's = Year "Meets"
Safety Performance [1] - Contractor	
RII[2]	0.20 – 0.25
LWC	0.05 – 0.10
Safety Performance [1] - Engineering	
RII[2] / LWC	0.00
Safety Performance [1] - Manufacturing	
RII[2]	0.20 – 0.25
LWC	0.00

Notes: *(1) Rates per 200,00 man-hour; (2) RII (Recordable Injury Incident) = NLWC + LWC.*

Two different safety handbooks have been developed, one for Construction sites, called Construction Safety Handbook, and another for the two mechanical factories, called FEC/FATRAN Safety Handbook. The intent of this splitting was to accomplish specificities and different requirements in terms of teams and activities. While the two mechanical factories used to have a majority of WMGI employees as a working

team, using contractors to face workload variations, WMGI/GSS group doesn't perform constructions, but uses to hire third-part companies (Contractors) for this job, actuating on their contract administration and work execution during the short period of time their construction activity uses to take.

3.1.1 Construction safety handbook

This handbook was originally designed to provide a tool for the Praxair personnel in their effort to manage safe construction worldwide. While the structure of this document is geared to Praxair's capital construction, the process described here can be applied to any contract, which includes an annex called Contractor Rules for Construction Safety (RULES), which establishes all safety requirements for a construction contractor working at a Praxair site. For WMGI use, the Handbook and specially this annex were translated into Portuguese, adapted and revised to accomplish Brazilian law and standard requirements. Our construction safety strategy is to manage implementation of prevention through planning, contract administration, and management of work execution. The basis for all contractor compliance to safe work practices is regulatory requirements and management of the work they are performing. Expectations must be set during project planning and the contract release. Contractors must be qualified and selected for the work assigned. Each project must have a Praxair Project Safety Plan (PSP) developed and in place to allow steps to be followed. Therefore, this RULES shall be issued to all contractors during the bid phase in order that they take all these requirements into consideration and also produce a Site Specific Safety Plan (SSSP) detailing how they will perform work safely prior to starting a project, and each contract must include RULES as a basis for managing the contractor for safety. Diligent use of this Safety Handbook by Praxair/WMGI supervision, and follow-up, will help ensure that the management is effective.

The basis for achieving this result is in the contract itself. Therefore, Construction Safety Handbook presents seven sections for which the following steps need to be accomplished:

- Section One establishes overall work process and administrative requirements. It's important that Praxair and Contractor teams upon visiting projects, review and understand both the Praxair PSP and Contractor SSSP;
- Section Two covers Observations that shall be planned and conducted during the site work to identify hazards and at risk behaviors, communicate, and document them. Documentation of findings, action, and performance will assist Praxair in the ongoing administration of a given Contractor;
- Section Three has an alphabetical list of issue areas where current work may be underway. There are small checklists for each topic (58 total) as a first approach to certify safety compliance on fieldwork. Using the site schedule, plan, and contract, Praxair and Contractor teams can determine which requirements apply to that project at this time and take actions as described below:
  - Select the activity underway or program to review (e.g., stairs, scaffolding, housekeeping, confined space, cranes, fire protection, etc.);
  - Use the questions provided on the selected topic to observe the activity. In each case these questions should all be answered affirmatively, demonstrating safety compliance;
  - Note the number(s) assigned to the topic observed if you wish to observe further and require more detail, question methods in use at the time of your observation, or answers are to the negative. If any of these is true, proceed

to Section Four and locate the corresponding checklist. If they are to the affirmative, move on to another topic as planned.

- Section Four provides checklists (same topics of Section Three) with much more details on what safety precaution should be taken for the topic selected. These checklists do not provide all requirements in the subject area or cover every possible method that may be used. They do provide guidance of the minimum requirements of what must be done to accomplish the subject area safely. Other source documents, experience or procedure can be applied if the hazard warrants. However, these are the areas where Contractors are contractually obligated to comply with. If there is any disagreement of the points identified in the checklists, a copy of RULES is provided in the back of the handbook for easy reference. The topic number assigned in Sections Three and Four corresponds to the paragraph number for that topic in RULES. These requirements are contractually bound and at this point, disagreements should be addressed on that basis;
- Section Five describes the process to follow when conducting a planned assessment of the facility or project;
- Section Six contains “Best Practices” for projects. This information is provided as a guide to assist the project in execution, and explain highlighted high-risk areas requirements with solutions.

3.1.2 FEC/FATRAN safety handbook

WMGI has adopted an operating policy to conduct business in a manner that would protect the safety and health of all team members. The highest priority is placed on establishing and maintaining a safe and healthy work environment, and for the elimination of work-related injuries and illnesses. Based on that, this safety fabrication handbook was originally written in Portuguese to provide a tool for WMGI employees and contracted personnel in their effort to address safety aspects of each activity of factory workers, according to Brazilian law and standard requirements.

A pocket version was distributed for every factory employee and contractor and they were all trained to understand the safety requirements and the use of the Handbook as a guide for any day-by-day activity, expressed on 52 safety topics, like personal protective equipment (PPE), lock-out/tag-out (LOTO) procedure, confined spaces, moving cranes, welding, and also Contractor and supply safety. This pocket handbook is supposed to be carried by everyone inside factories as a helpful tool for safety aspects. A complete handbook version was developed for fabrication supervisors and management teams, including two more sections, in addition to the first one, which describes safety requirements for each factory activity, as presented in the pocket version, with similar philosophy adopted in the Construction Safety Handbook, regarding the checklists of Sections Three and Four. Therefore, factory supervisors and management personnel – actually WMGI employees – can use these checklists for observations to verify compliance with safe work practices, and management of the work they are performing inside shop floors, or at the field assembling and maintenance.

3.2 Phase Two: At Risk Behaviors and Unsafe Conditions Observation System

The safety strategy is to manage implementation of prevention through planning, workers administration, and management of work execution. Behavior observations

of contractors and employees shall support our safety strategy. We can and must observe for safety. However observations must ultimately address the management system intended to prevent any at risk behavior and unsafe conditions observed.
There are two important aspects in a safety observation system to achieve success: effective observation must be observation of behaviors of people performing their work and management's control of that work; and observation with respect to safety must be narrowed to observation of existing hazards – represented by at risk behaviors – and potential (on unsafe conditions) as they relate to people.
This second phase has started in FEC and FATRAN factories' shops as a trial of behavior-based safety observation system and revealed itself consistent during 2001. At the beginning of 2002 this safety observation system was adapted for construction sites with the same approach and results. For both working areas, the same main criteria were implemented:

- Safety supervision personnel at the sites shall conduct the system, i.e., actually the safety technicians from WMGI and Contractors, and GSS site supervisors. They are trained to understand the safety requirements and the observation system methodology in order to be facilitators and its focal points;
- Construction sites need to have a minimum schedule of three months to apply this safety observation system. From a practical standpoint, less than three months would create useless information for the site's safety staff regarding the dynamism of a small construction activity, i.e., when the first month observation report would be sent – probably regarding the civil construction phase – there would be nothing to do at the site, because this phase would have been actually concluded;
- Two observations a week per site shall be conducted to generate enough data for a monthly basis analysis and report;
- Observations have to be done at least in pairs, i.e., the safety technician shall invite another professional at the site to join him/her for each session. From a practical standpoint, this guest can be anyone working or visiting the site – an administrative or technical employee or contractor – because the main idea here is to gain a cross training session considering the more accurate safety skill and knowledge of the safety staff, which would certainly provide safety training for the invited professional, but on the other hand, specific skill or knowledge of this guest (or at least "new eyes" on routine activities) would represent specific learning for the safety supervision. For example, clearly an experienced electrician may detect safety issues on site installations or during electrical practices that the safety professional would not be trained to identify;
- Observers shall use a specific Protocol report, which will be an observation report of at risk behaviors and unsafe conditions seen and corrected during each session. This protocol is divided by different standardized site observation areas, which provide a logic database for comparison and safety analysis. Table 2 shows these areas for a generic construction site and for the main factory (FEC);

Table 2. At risk behavior observation system protocol's area separation for construction sites and FEC

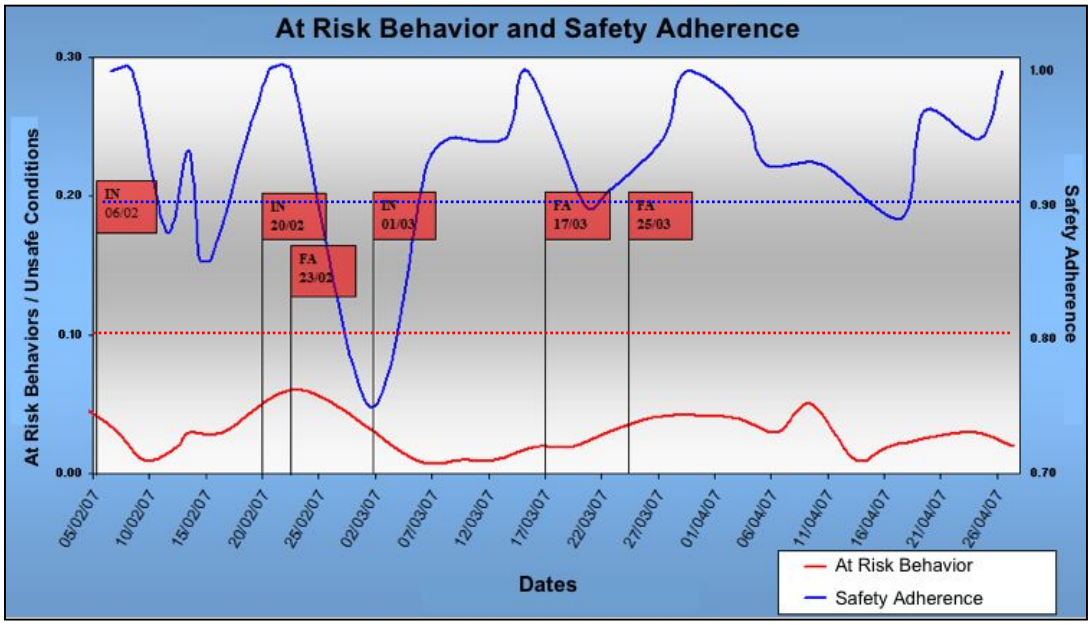
Protocol's Observation Area	Construction Site	FEC
Area 1	Main construction area	Cold Box Shop
Area 2	Pipe shop (1) for Contractor #1	Tanks Shop
Area 3	Pipe shop for Contractor #2	VPSA Shop
Area 4	Administrative Area (4)	Preparation Shop
Area 5	Backup Area (5)	Metal Cutting Shop

Notes: *(1) Pipe shop is the Contractor's private working area for piping preparation, instrument calibration, metal or wood armature preparation, and other small tasks for construction and field erection; (2) For Contractors and WMGI administrative buildings, even restaurant and rest-room facilities; (3) For a third Contractor pipe shop at the site, or for a separate construction area.*

- For each observation, a protocol report shall be filled with the site name, the date of the observation, the name of the safety representative in charge of the task and the invited professional. During the observation process, the observers register on each protocol report field (by site area) at risk behaviors and unsafe conditions captured and immediately corrected, which may involve prompt action and/or discussion (for example, two Contractor – with name – employees without hard hat means two at risk behaviors while a scaffolding with not tighten wood plates means one unsafe condition). There are also report fields to inform the approximate number of workers (by Company, i.e., WMGI's or Contractor's employees. It has just statistical purposes, because the Company's treatment is the same for employees and contractors) at the area during the observation period. Depending on the site size and the number of tasks being performed at the area during observation, a complete observation may take from 30 to 60 minutes;
- All observation reports for each site during a month are sent to the GSS engineering safety management for data calculation and graphic consolidation into a spreadsheet. With the number of findings (at risk behaviors and unsafe conditions) observed for each area, a finding index (Weight Behavior) is calculated multiplying findings per workers observed on a centesimal basis. This index can be understood as the site non-conformance status, or in other words, the site "stress"[4] level, because unsafe behaviors and conditions, happening at the same time, at the same area, affecting different workers of different companies do represent a shared factor for safety instability to everyone while it remains. The goal established for this index, for each site, is less than 0.1;
- Based on this information we can plot a graphic showing this weight behavior index during each site lifetime, for all Companies working there (WMGI and Contractors), as a behavior-based "photograph" of the working area. We can also indicate incidents and accidents occurred at the site during the same period of time, as seen on Figure 1 for a construction site (Incident/accident flag colors indicate ownership and are related to Contractors' colors shown on the graphic's legend). Although it is not necessarily conditioned, these graphics frequently have brought up an evident link between the weight behavior index increase – at least for one of the working companies at the site – with the incidental events occurrence, revealing more than a coincidence, but a consistent trend;

[4] *Stress shall be understood as synonym of lack of adaptation (related to worker-activity integration) or imbalance on safety work conditions, generating errors, which will be observed on at risk behaviors and unsafe conditions usually performed at the site, contributing to contaminate safety behavior-based status of all workers, as a contributing factor on incident and injury basis.*

Figure 1. Example of the At Risk Behavior/Unsafe Condition Observation System index plotted with the Safety Adherence Observation System index for a construction site



- Additional information is also available from this calculation, like a Pareto comparison of at risk behaviors and unsafe conditions for one site or a specific Contractor at a construction site, and a Pareto indication of findings for different site areas. We can also compare Contractors or even sites performance, and also get informed about the most important types of at risk behaviors or unsafe conditions, that have been more frequently observed in recent weeks or for a long period of time at the site. The most significant ones are pointed out for site safety staff for special attention and actuation, as part of an action plan. For all these information, the system provides a monthly basis picture and a complete accumulated data for an operation profile during the site lifetime.
- A monthly report, which represents a specific behavior-based “picture”, is generated for each site, with objective safety management team recommendations for the site safety staff, as an action plan to be followed up, in order to preventively correct issues and provide specific support and training to get performance improvement.

3.3 Phase Three: Safety Adherence Observation System (PPI)

Efforts must be directed at reinforcing the safety planning and the behavior of the worker’s management. Especially regarding construction sites, most contractors are not sophisticated enough to include behavior-based safety directed to their employees as part of their safety systems. The actions of workplace personnel are the result of those systems and the environment that has been created at the site. In the end, our success is dependent on our ability to communicate expectations and observe the actions of the management team, and the actions of the site workers.

Although the search to accomplish corporate KPI’s and implement a safety observation system to capture and correct at risk behaviors and unsafe conditions is

fundamental to any workplace safety strategy, there are two common characteristics on these processes that have impelled us to introduce a new safety observation system, using a different approach, that could represent a safety process performance indicator (PPI): the first, is related to the negative aspect to point out and chase to avoid errors or incidental events and injuries. Their occurrence always involve unsuccessful and failure feelings on the team, usually borne of bad news to safety efforts. Especially regarding incidents and injuries, the average sensation is quite similar to a soccer game, where the best result for our team is just a 0 X 0. Any event represents a defeat and makes our mind asking why did it happen after all the efforts, systems, tools, skills, and procedures we put in place? And frequently, we used to answer ourselves with "they were still not enough"; even considering the aggressive goal we've set for our company's safety strategy. The second issue addresses the incapability of these processes to expose all team efforts in improving safety awareness, teamwork, communication, problem solving, strengthen safety training and learning (on different processes, technologies, procedures, standards, and management systems) and creating a real safety culture, expressed by the workers adherence to design and task safety reviews, job safety analysis, site assessments, technical and safety requirements, and operational discipline, regardless the problems with adaptability (temporary contractors and cultural diversity). All these factors may be called an actual "invisible" effort, reinforcing some team frustrating sensation.

Observations can be made at any time by using the safety handbook checklists. They are structured to allow any WMGI employee, at any knowledge level, to perform workers oversight for safety, observing at risk behaviors, assessing site's management of safety and the overall safety performance of workers (contractors and employees), conducting contractor administration, and learning about safety requirements. Although these safety observations have been initiated on all GSS sites since the introduction of safety handbooks, this third phase, as a systematic safety adherence observation system, has started on December 2006, based on similar main criteria for construction sites and GSS factories:

- GSS safety supervision personnel at the sites shall also conduct the system, i.e., actually the safety technicians and site supervisors. They are trained to understand the safety requirements and the observation system methodology in order to be facilitators and its focal points. In the case of construction sites, the contractor's management shall be present during the observation in order to guarantee a good feedback and understanding;
- The key is the knowledge of what to observe. GSS (factories and construction) handbooks are structured to give the necessary knowledge to the supervision to observe the major activities relevant to ensure safety of construction and fabrication. Observing is an activity that can be done at almost anytime, given preparation, planning, and some guidelines;
- In order to facilitate and standardize this kind of observation, handbook checklists were grouped by subject or interest area – the Construction Safety Handbook has 18 different checklist groups as indicated on the subtitle of Figure 2 – providing guidance and a way to verify the minimum requirements of what must be done to accomplish safety at the subject area, as defined in the handbooks text. As an example, on Construction Safety Handbook, the fifth checklist group (Barricading and Area Access) covers the specific checklists for "Barricading Work Areas", "Access and Egress in Construction Areas", and "Lock, Tag, and Try Procedures". One checklist group shall be used and fulfilled

on each safety adherence observation. Each checklist item has three possible answers: “Yes” for a desirable compliance level on the checked item; “No” for non conformance (finding) detected for an item; and “NA” for a not applicable item on the activity that is being observed;

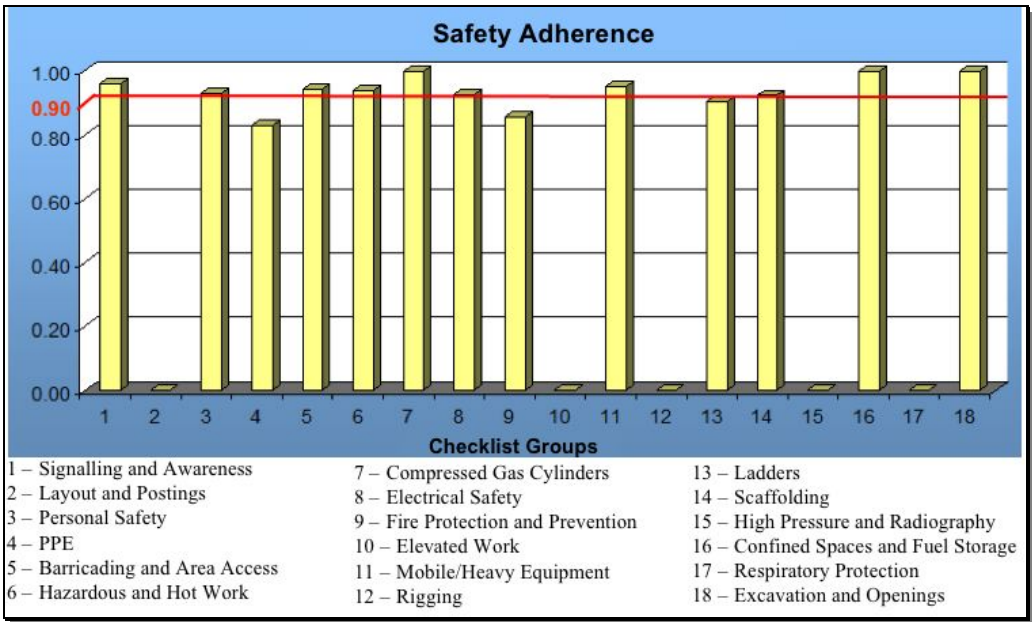


Figure 2. Example of an actual Safety Adherence index result for each observed checklist group at a construction site

- GSS safety supervision personnel shall plan safety adherence observations to be done at least twice a week in a sequence that all checklist groups can be used as a tool for observers in a shorter period of time – schedule changes may be done based on dangerous activities for an specific occasion. All observation checklist groups completed for each site during a month are sent to the GSS engineering safety management for data calculation and graphic consolidation into a spreadsheet. By just considering applicable answers – “NA” answers do not apply for calculation – the safety adherence index is obtained by dividing the total number of “Yes” answers by the total applicable ones (“Yes” plus “No” answers). This index can be understood as the site safety conformance status, or in other words, the site adherence monitoring system regarding safety procedures and requirements, previously established, in which all employees and contractors were trained and agreed to follow. The goal established for this index, for each site, is more than 0.9, as indicated in Figure 2 for an actual construction site. The ones with unsatisfactory adherence levels are pointed out for the site safety staff and management supervision for special attention and actuation, as part of an action plan;
- Based on this information we can display the safety adherence index on the same graphic showing the weight behavior index (of At risk observation system) during each site lifetime, for all Companies working there (WMGI and Contractors). These safety adherence results complete the At Risk Behavior monthly report, generated for each site, representing a complete behavior-based “photograph” of the working area, regarding undesirable conditions and behaviors, and a demonstration of the safety compliance level according to our requirements, as seen in Figure 1 for an actual construction site;

- Although it is not necessarily conditioned, these two curves, put together in Figure 1, frequently have brought up a quite evident link between the weight (at risk) behavior index increase with the safety adherence index decrease (and vice-versa), revealing more than a coincidence, but a consistent trend. Nevertheless, these observation systems do not represent opposite versions, or the inversion of each other. In fact, while At Risk Behaviors and the Unsafe Conditions Observation System capture objective unsafe actions and environmental potential hazards created at the site, the Safety Adherence Observation System intends to verify compliance with procedures, programs, documentation, accountabilities, updated designs, maintenances, permits, investigations, knowledge status, precautions, training evidences, and all such things that can demonstrate a complete safety compliance with the handbook that is supposed to be followed for each observed activity.

4 CONCLUSIONS

All the WMGI implemented activities described here have proved to be an efficient safety management tool for behavior-based monitoring of working areas for any kind of industry (fabrication or construction sites). They are also easy and almost inexpensive to implement, creating important effective preventive results from a practical standpoint, and also promoting safety culture and organizational climate improvements.

Observation and feedback can powerfully affect how the worker performs. By having knowledgeable observers watch a working environment, safe and at risk behaviors, and also unsafe conditions and process compliance can be measured. Immediate feedback provided by the observer and management team can actually point out the work done safely. The observer can coach improvements to replace at risk work behaviors with safer methods and share safety and technical skills with other invited professionals. This process must be accomplished with the site's supervision hoping that they will lead the discussion. A well-designed system arranges brief positive coaching interactions between the worker and the observer. Effective feedback is immediate, specific, and constructive, also delivered by a creditable co-worker. Usually the worker has an immediate opportunity to try the recommended changes by resuming work using the new skills. Sometimes behaviors change easily, others are hard to break. Repeated coaching interactions are needed to reinforce behavior changes. Many studies have shown that this approach will change even well entrenched habits. The process changes how people interact at work and safety becomes an accepted topic of conversation. Workers become more comfortable alerting each other of hazards. Knowledge about safety is shared as the observations detect improvements and bring them into the coaching process. Depending on the industry profile, there is emphasis on managing the contractor's management systems. This coaching and interaction allows the company's management team to determine the extent and value the workers (employees and contractors) give to safety. Documentation of this activity is a critical system that collects and distributes data on observations, follows up safety performance, and communicates safety evolution to all organizational levels.

And finally, as a natural tendency, this safety management tool, with all systems associated, will certainly provide a new company core competence, as defined by Hamel and Prahalad,[(2)] developing this process as a fundamental issue to improve strategic changes and competitive advantages within the industry environment, and to create value for customers, with a probable new market entry for safety services, as discussed in Figueiredo.[(3)]

REFERENCES

1 HEINRICH, H.W. Industrial accident prevention. New York: Mc-Graw-Hill, Inc., 1931.
2 HAMEL, G.; PRAHALAD, C. K. The Core Competence of the Corporation. Harvard Business Review, 68(3), 1990.
3 FIGUEIREDO, A. F. Z. DE. The chemical industry using its competences in new markets: the service offer. Chemical and Biochemical Technology Master's thesis - Management and Technological Innovation Area. Escola de Química, Universidade Federal do Rio de Janeiro, Rio de Janeiro (in Portuguese), 2005.

BIBLIOGRAPHY

1 CAPONI, A. C. Proposal Method for Hazard Identification and Building Construction Risk Evaluation and Control. Civil Engineering Master's Thesis. Universidade Estadual de Campinas, Campinas, (in Portuguese). 2004.
2 FEC/FATRAN – Safety Handbook, WMGI (Praxair Inc.), Rio de Janeiro (in Portuguese), 2006.
3 GSS Construction Safety Handbook. Praxair Inc., Tonawanda, NY, 2003.
4 NEAL, A.; GRIFFIN, M. A.; HART, P. M. The impact of organizational climate on safety climate and individual behavior. Safety Science, v. 34, p. 99-109, 2000.