THE RISK MANAGEMENT SYSTEM
IN GERMAN HARD COAL COMPANIES
AND THE TRANSFERENCE TO SOUTHEAST ASIA

Von der Fakultät für Georessourcen und Materialtechnik
der Rheinisch-Westfälischen Technischen Hochschule Aachen

zur Erlangung des akademischen Grades eines
Doktors der Ingenieurwissenschaften

genehmigte Dissertation
vorgelegt von Master of Economics

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aus Hanoi, Vietnam

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Univ.-Prof. Dr.-Ing. Dipl.-Wirt. Ing Per Nicolai Martens


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PREFACE

The mining industry, especially in emerging countries like Vietnam, uses much artisanal labor. Traditionally, workers joining this field are simply not adequately equipped to perform the job safely. Mining is a teamwork profession, and thus relies heavily on safety. If this level of safety is lacking, then the consequences are usually much greater than anticipated.

Since risk management was chosen for my master dissertation in 2005, the statistical data and the state-of-the-art safety management in Vietnamese mining industry showed various serious incidents, and accidents were a result of low safety competence at work.

Therefore, when I had a chance for further study, I decided to put more effort into finding solutions to technical risks in mining enterprises in Vietnam. Working in education gives me the opportunity to contribute to the training aspect in order to establish a safe mining culture to prevent accidents.

I completed my dissertation with much support from my husband and my little daughter. My husband is the first person who told me that if I want to improve my career in research and education fields, I should study further in Germany. He passed on some opportunities in his career but has never given up his support to me. My little daughter has been making sacrifices as well. Not having her mother by her side, she misses out on the nightly tucking in at bedtimes and, the simple gesture of me wiping off her tears when she falls or sharing her favourite treats with me. And being thousands of miles away from her, I have missed a lot of her important milestones and events, such as her birthdays, her performances in kindergarten, her school opening ceremonies, etc. She is the motivation for me to finish my PhD program in time, in order to be home, and be with her on her first day of elementary school.

My program could not be completed without the thoughtful “Betreuung” that I received from my supervisor, Professor Doctor Jürgen Kretschmann, the apl. Professor at the Rheinische Westfalia Technische Hochschule (RWTH) Aachen, Mining Institute 1. He is more than a supervisor to me, as he always encourages me and motivates me during my challenging time in Germany. Knowing well the situation of a young mother living far away from her family, not only did he care
about my mental and emotional condition, he also gave me every single chance of working in Vietnam so that I could spend time with my family. Besides from learning how to be a scientist from him, I also learned how to be a better lecturer, how to motivate my students, how to contribute to the mining community and much more. I never expected these things from a supervisor and therefore, I would like to express my very special thanks to him.

My special thanks to Professor Doctor Per Nicolai Martens of RWTH Aachen, Mining Institute 1, who gave me a lot of support during my study at this university, Professor Doctor Ngo The Binh of the Hanoi University of Mining and Geology, who has given me a lot of motivation since our first joint project in science in 1999 when I was a student, Professor Doctor Nguyen Canh Nam of the Vietnam National Coal, Minerals Holdings Corporation Limited (Vinacomin), who was the first person that suggested research on risk management and always trusts in my capability to contribute in the Vietnamese mining industry. I received much support from Professor Doctor Christoph Dauber, the Vice President of the University of Applied Sciences Georg Agricola in Bochum and Mr. Dipl – Ing. Dieter Mantwill, the former Head of the Department of Occupational Health and Safety and Environmental Protection of RAG Aktiengesellschaft (RAG). Without their support, I would not have been able to develop my thesis.

For the technical part of my thesis, I would like to thank Mr. Dipl – Ing Helmut Ehnes, the General Secretary of International Social Securities Association Mining (ISSA Mining), Mr. Uwe Olaf Küster, Department of Environmental Safety, Service sector workforce – Training Ruhr of the RAG, Mr. Nguyen Anh Tho of the Bureau Safe Work in the Ministry of Labor, Invalid and Social Affairs (MOLISA) of Vietnam, other members of Vietnam National Coal, Minerals Industries Holding Corporation Limited: Mr. Eng. Phan Van Thuy and Mr. MSc. Pham Chuong of Vang Danh Joint Stock Coal Company, Mr. Eng. Nguyen Huu Dat of Halam Joint Stock Coal Company, Mr. Eng. Duong Van Tinh of Company 86 in Dong Bac Corporation, Mr. Dr. Phung Quoc Huy of Mine Safety Center and other miners and staff members. I do hope that our cooperation will continue for the sake of the mining community.

To my colleagues and students in the Mining Management Department in Hanoi University of Mining and Geology, I thank you for always standing beside me. As I
have not been a lecturer for very long time, my colleagues, must also take over my responsibilities in addition to their already hectic workloads. My former students who are working in different mines in Vietnam also helped me much in my study. I thank all of you very much.

To my parents and my parents-in-law, I would like to show my deep and sincere gratitude for their support, thoughtfulness, and for caring for me and my family during my absence. I do believe that they will be satisfied and pleased with my achievement, as in Vietnamese traditional conception, parents are always happy when their children have succeeded more than they ever could.

Last but not least, I also want to thank all of my friends for their exchange of precious and helpful experiences and sharing my ups and downs throughout the last three years.

With the financial sponsorship from the Vietnamese government, represented by the Vietnamese International Education Department, together with the German Academic Exchange Program (Deutscher Akademischer Austausch Dienst - DAAD), I have been given a chance to study further in Germany, one of the most advanced educational systems in the world. I would especially like to thank the two organizations and dedicate every success in my thesis to the mining community in my homeland.
INTRODUCTION

Risk management is an integral part of corporations along with other functions such as financial management and technical management and therefore has been studied for a long time.

Advanced mining industries have been conducting a lot of research to mitigate risks. German coal mines and business firms normally use risk matrices to identify and find solutions to them\textsuperscript{1,2,3,4,5}. Risk management is also required in the legislative system with the Law of Control and Transparency in Enterprises (KonTraG), in order to protect the firms from losses when risks occur, which has been implemented since 1998. Risks statistics have been calculated for flammable gas explosions and combustion in Japanese coal mines in different categories. From those results, disaster rates per million tonnes of production and per million workers were illustrated by mining depth\textsuperscript{6}. Japanese risk managers paid much attention to labor accidents and occupational diseases, which are considered one of the most serious causes of losses\textsuperscript{7}. The Department of Mineral Resources in Australia issued a handbook in risk management in 1997 for their mining industry\textsuperscript{8}. Those are examples of efforts made by these countries to better deal with many kinds of risks in the mining industry.

The field of occupational safety and health (OSH) is considered an important part of risk management\textsuperscript{9}. The International Labor Organization (ILO)\textsuperscript{10} has published a

\begin{itemize}
  \item \textsuperscript{1} RAG Corporation (2009), \textit{Risikomanagement(RCM) – Handbuch der RAG Aktiengesellschaft}
  \item \textsuperscript{2} J. Kretschmann, S. Kullmann (1999), \textit{Risikomanagement bei der Deutschen Steinkohle AG im Rahmen des Gesetzes zur Kontrolle und Transparenz im Unternehmensbereich (KontraG)}, Bergbau 11/1999
  \item \textsuperscript{3} J. Kretschmann, N. Nguyen (2010), \textit{Some aspects of transferring risk management system from German mining companies to South East Asia}, Presentation at the strategic conference: Prevention – risk management – social security: “The Seoul – roadmap towards better safety and health at work”, in frame of the National Safety Week, Hanoi, Vietnam, March 2010, available online at http://www.issa.int/aiss/content/download/126678/2589571/file/
  \item \textsuperscript{4} J. Kretschmann (1999), \textit{Risikomanagement gemäß KontraG und die Umsetzung im deutschen Steinkohlenbergbau}, Glückauf 135
  \item \textsuperscript{5} F. Romeike (2002), \textit{Risiko-Management als Grundlage einer wertorientierten Unternehmenssteuerung}, RATINGaktuelle February 2002, p. 12 - 17
  \item \textsuperscript{8} Australian Department of mineral resources (1997), \textit{Risk management handbook for the mining industry}
\end{itemize}
code of practice on safety and health in underground coal mines\textsuperscript{11}. ILO codes of practice are used to evaluate workers’ health, the work environment, and establish an OSH management system in the public and private sectors. The public and private sectors are responsible for the safety and health management of occupational hazards such as chemicals, heat, noise and vibration, as well as the following work sectors: construction, forestry and mining\textsuperscript{12}.

Vietnam has not established any models, handbooks, or specifications in risk management other than Circular No 03 in 2011 published by the Ministry of Industry and Trade\textsuperscript{13}. In the mining industry, a systematic analysis and assessment of risks and risk management was not implemented until 2009, conducted by the Mine Safety Center\textsuperscript{14}. Risk control activities were separated from occupational health and safety, fire and explosion protection, flood defence and other natural disasters\textsuperscript{15,16,17}.

According to annual reports of the Bureau for Safe Work – Ministry of Labor, Invalids and Social Affair (MOLISA Vietnam), mining and construction industries consistently have the highest number of fatal accidents\textsuperscript{18}. These two industries have high risk work, and thus, risk management should become priority.

\textsuperscript{10} International Labor Organization (ILO) is the international organization responsible for drawing up and overseeing international labor standards. It is the only ‘tripartite’ United Nations agency that brings together representatives of governments, employers and workers to jointly shape policies and programs promoting Decent Work for all. Today, the ILO helps advance the creation of the economic and working conditions that give working people and business people a stake in lasting peace, prosperity and progress. Its tripartite structure provides a unique platform for promoting decent work for all women and men. Its main aims are to promote rights at work, encourage decent employment opportunities, enhance social protection and strengthen dialogue on work-related issues.

Official website: http://www.ilo.org/

\textsuperscript{11} International Labor Organization (ILO) (2006), \textit{Codes of practice on safety and health in underground coal mines} (2010)

\textsuperscript{12} International Labor Organization (ILO) (2006)


\textsuperscript{14} Q.H. Phung et al. (2010), \textit{Surveillance and assessment the state – of – the – art in occupational accidents caused by violence discipline of labors in coal collieries. Solutions for minimization of occupational accidents (pilot program in some business units)} (Vietnamese)

\textsuperscript{15} Ministry of Labor, Invalid and Social Affairs and Ministry of Health (2011), \textit{Joint circular 01/2011/TTLT – BLĐTBXH – BYT guiding the implementation of occupational safety and hygiene in working units (10/1/2011)} (Vietnamese)

\textsuperscript{16} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2010a), \textit{Annual report on occupational safety and health} (Vietnamese)

\textsuperscript{17} Ministry of Industry and Trade (2010) \textit{Circular 43/2010/TT – BCT Regulations in safety management in industry and trade (29/12/2010)} (Vietnamese)

\textsuperscript{18} Ministry of Labor, Invalid and Social Affairs, \textit{Annual reports on national accidents (from 2006 – 2010)}, Synthesized data (Vietnamese)
Motivation for studying

While excavating, different kinds of high potential risks may occur over time. Hence, advanced mining industries such as ones from Germany, Japan and Australia have been carrying out research on risks. However, Vietnam has not conducted any adequate research on this subject. Despite a long history of the coal mining industry, risks and risk management have not been a priority or researched in Vietnam. Meanwhile, in coal mining companies, risks have increased for the following reasons: (1) search and exploration are more difficult and complicated; (2) integration of Vietnam into the World Trade Organization has increased competition in the domestic and international coal market; (3) environmental protection has become more important, and increased; (4) energy security is a big problem for all countries in the world, including Vietnam, leading to production pressure to the workforce especially to the people working underground in this country.

The Vietnamese coal mining industry has been developing rapidly, as it supplies coal not only for domestic demand but also for international consumption\(^\text{19}\). In the forthcoming years, coal output will be based on underground mines, as opencast coal mines will be closed for many environmental reasons (such as waste dumps and dust), and economic ineffectiveness\(^\text{20}\).

Vinacomin realizes the role of risk management and occupational safety and health in dealing with uncertain dangers and hazards. Even though in 2010, the Vietnamese coal mining industry invested about 700 billion Vietnamese dong (approximately 28 million Euros) for their safety programs, there were still 35 fatal accidents with 42 fatalities\(^\text{21}\). Data from 2001 to 2009 shows an increased trend in the numbers of incidents and fatal accidents.

\(\text{19}\) Official website of Industrial Review of Vietnam (ISSN 1859 – 3992): Coal exports achieved 1,549 million US dollars in 2010, ranked the 11\(^\text{th}\) of 18 goods which have exports of over 1 billion US dollars
http://www.tapchicongnghiep.vn/News/channel/1/News/357/14762/Chitiet.html (Vietnamese)

\(\text{20}\) Vietnam National Coal, Minerals Industries Holding Corporation Limited (2010b), Guidance for building planning for cooperation with other companies in 2011 and preparation for signing agreement the 2011 – 2015 period. Official dispatch No. 3897/TKV-KH of Vietnam National Coal, Minerals Industries Holding Corporation Limited to subsidiary companies

\(\text{21}\) Vietnam National Coal, Minerals Industries Holding Corporation Limited (2010a)
### Table 0.1  Number of fatal accidents in underground in different categories from 2001 to 2009

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity (mn.t)</th>
<th>Total of deaths (1)</th>
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### Table 0.2  Number of fatalities in collieries in different categories from 2001 to 2009

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<td>2004</td>
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Categories of accident: (1) Gas explosion; (2) Gas asphyxiation; (3) Water inrush; (4) Chamber blast and rock burst; (5) Mine explosion; (6) Electric shock; (7) Logistic, equipment operation and reparation; and (8) Others causes

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22 Vietnam National Coal, Minerals Industries Holding Corporation Limited (2009a), Occupational safety and health report (Vietnamese)
The main reasons for the above accidents are obviously from the technical conditions and complexity of the geological conditions in the collieries. The mine sites are located in different areas, thus, it is also difficult to place mechanized equipments. Those are the main causes of most accidents with large numbers of fatalities caused by chamber blast, rock burst, gas explosion, and gas asphyxiation, as shown in the above tables.

However, according to the research from the Mine Safety Center between 2005 and 2009, 95% of incidents and accidents in collieries were caused by the labor force. About 0.6% were attributed to other conditions such as geological and technical conditions and 4.4% came from both labor and other conditions. Chamber technology allows the reduction of the number of manual workers at coal faces and thus can reduce risks. Nevertheless, some incidents and even a fatal accident occurred due to irregular inspections, unrealized risks, and untimely response to accidents. Additionally, workers wander into forbidden locations in the mines and fail to comply with safety guidelines while working in chambers. Unpredictable and unpreventable conditions such as water inrush over an upper furnace in a second shift washed away soil and coal and filled up a furnace to approximately 85m and killed two workers. Although working in a mine with high alarm of gas and dust explosions, workers and team leaders on a Monday morning did not fully implement technical standards in repairing electric equipments. As a result, fire occurred due to a dysfunctional ventilation system during the weekend and 8 people died. In Vietnam mining industry, there is little mechanized equipment unlike in other countries and therefore using artisanal labor force is unavoidable. Due to this fact, risk management in Vietnam should be taken seriously through various forms of education and training, financial incentives, and knowledge and technological transference.

The German coal mining industry is a good role model on risk management for Vietnam. For a long time, the Ruhr Valley in North Rhine Westphalia has been a large coal excavation and industrial area. Their economy is similar to that of Quang Ninh – Hai Phong – Ha Noi in North Vietnam. The output quantity of open-cast

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23 Q.H. Phung et al. (2010), p. 20
24 Q.H. Phung et al. (2010), p. 30
25 Q.H. Phung et al. (2010), p. 29
mines in Quang Ninh will be reduced and the Vietnamese coal mining industry will be based mostly on underground excavation. Mining enterprises in Quang Ninh can learn from the coal mines of the German Hard Coal Company (Deutsche Steinkohle - DSK) on how to handle risks. A handbook of risk and chance management in mining management was proposed by one of the German’s largest consortiums, RAG Aktiengesellschaft (RAG)\(^{26}\). There is also the close collaboration among miners, companies, unions and authorities (hereafter called stakeholders) in order to reduce the accident rate in the German coal mining industry\(^{27}\); in 2010 the ratio was 4.6 accidents per 1 million working hours, lower than the ratio of other industries\(^{28}\) and by the end of May 2013 the accidents per 1 million working hours were 3.7\(^{29}\).

German coal mining companies are willing to share their advanced technology and to exchange their experiences with others, and have been implementing a risk management system that has resulted in reduced fatalities and incidents. Not only can these losses be controlled but these advancements can be sustained. Although the decrease of incidents and accidents in RAG is a consequence of eliminating excavation\(^{30,31}\), it is also a result of putting more effort into risk management\(^{32}\). Over the years, German mining has built up an international reputation based on the success of its know-how and technology. German engineering expertise, acquired over many years in the mining sector, is now highly sought after around the globe.

\(^{26}\) RAG (2009)

\(^{27}\) W. Hermülheim, R. Schumachers, C. Dauber (2009), *Occupational health and safety and hazards control in coal mines*, Mining reporter online Vol 1/2009, p.39

\(^{28}\) Official website of RAG Aktiengesellschaft: http://www.rag.de

\(^{29}\) M. Junker (2013), *The problem facing the international mining industry when working at deep levels – German know-how provides the answers*, Presentation at the 4th International Symposium Mineral Resources and Mine Development, Aachen 2013

\(^{30}\) dw-tv.de: Article published on 31/01/2007: *The rise and fall of Germany’s coal mining industry*: “In Germany, from 1960 to 1980, the number of mines fell from 146 to 39. By 2000, only 12 were still operating, with output down to 20.7 million tons in 2006 from 150 million tons in 1957. While some 610,000 were employed in the mines in 1977, the figure was well under 50,000 in recent years.

\(^{31}\) Official website of RAG Aktiengesellschaft: http://www.rag.de: To August 2011, as reported, RAG produced about 13 million tons of coal per year, assisting energy supply security. They employ a workforce of about 25,000 people and provide training places of about 1,100 young apprentices. But by 2012 the production will be decreased to 12 million tons and the workforce will be also reduced to under 15,000 people

\(^{32}\) http://steinkohleportal.de/content.php?id=1039&DocID=1725&ParentID=1026: In West mine – one of five mines in North Rhine-Westphalia, author’s note – for over ten years there has never been any recorded accident (information available in September, 2011)
The German coal industry is second to none when it comes to mining technology and health and safety standards.\(^\text{33}\)

In Southeast Asian countries, risk management has been carried out in national programs such as the ASEAN OSHNET (Asean Occupational Safety and Health Network), which was launched by the ILO Program for the Improvement of Working Condition and Environment in 1976. This network has been increasing awareness, knowledge and motivation of industrial society, including small and medium enterprises, to implement occupational safety and health (OSH) at workplaces properly and improve their working conditions. These efforts can contribute significantly to the promotion of human resources development, and to the creation of productive and competitive manpower. In addition, harmonization of standards and guidelines can minimize technical barriers among the ASEAN countries in dealing with AFTA (ASEAN Free Trade Area) and globalization. The program can also accelerate the effects of OSH programs and other services in the region, and realize the vision of “a partnership in dynamic development” as stated in the ASEAN Vision 2020 Statement.\(^\text{34}\)

Based on the above reasons, a study on the risk management system in the German coal mining industry and the possibilities of transference this system to Southeast Asian mining industry is necessary, as these mining industries will expand in order to meet the high demand of the world economies for raw materials.

**Research purposes**

The main purposes of this research are to:

1. Provide an overview of risk management;
2. Find out what can be applied to the Vietnamese mining industry from the German mining industry;
3. Transfer the risk management system of the German mining industry to the Vietnamese mining industry;
4. Find the requisites for its successful transference and implementation; and

\(^{33}\) Official website of RAG Mining Solutions: http://www.ragms.com/?siteID=327

\(^{34}\) Official website of ASEAN OSHNET: http://www.aseanoshnet.org
5. Apply results of the research to mining industries of other Southeast Asian countries.

**Research objectives**

1. The risk management system and its benefits to the German coal mining companies, especially RAG Aktiengesellschaft;
2. Features of the Vietnam National Coal, Minerals Industry Holding Corporation Limited (Vinacomin) as the sole representative of the Vietnamese mining industry;
3. Application of three underground coal companies in Quang Ninh Province (representing for the 3 main areas of the coal basin: Uong Bi, Hon Gai, and Cam Pha) will be parts of risk management transference, for example training seminars; and
4. Some general features of the mining industries in Southeast Asian countries.

**Scope of the research**

Vietnam cannot implement all aspects of the risk management system of other countries in total, but can select certain aspects to adopt. Thus, in this dissertation, **technical risk management is priority** for the following reasons:

1. Geological conditions cannot be changed, but they play a major role in mining. Many of the technical risks occur due to exploration, planning, construction, excavation and underground transportation; and
2. Once technical risks are successfully managed, the labor force, business efficiency and the entire economy are less influenced by losses and damages.

The labor force is crucial and irreplaceable in emerging mining industries, where the majority of work is completed by manual labor (especially in underground mines). Technical risk management interacts with the improvement of occupational safety and health for intensive labors and social security. It will be necessary to establish technical risk management and training methods to increase safety and help in dealing with risks.
Main contents

The dissertation covers the following:

1. Overall theoretical and practical study on risk management and technical risk management systems in Germany and Vietnam;
2. Applications of the German risk management system in Vietnam especially through coordinating seminars for employers in three companies of Vinacomin: Vang Danh Coal Joint Stock Company (Uong Bi area), Ha Lam Coal Joint Stock Company (Hon Gai area), and Company 86 (Cam Pha area); and
3. Requisites and the (short-term) outcomes of the transference.

New concept of the dissertation

- Scientific concept:
  o The Vietnamese coal mining industry can learn from the German coal mining industry’s experiences in risk management, with the advanced perception of risk and chance management, so that stakeholders can take other chances besides finding out how to deal with risks;
  o Risk management should be considered an integrated management function in business; thus, for better effectiveness, it should play a strategic role and be set up as a system;
  o Risk management is the prerequisite of sustainable development, not only for companies but also for their employees and society, who enjoy the benefits of risk management, such as better safety and health conditions for workers, higher productivity, lower costs for compensation of damages and losses, etc.; and
  o This dissertation is one of the few pieces of research on risk management in the Vietnamese coal mining industry. It aims to help the Vietnamese coal mining industry to find plausible and adequate solutions for the improvement of risk management in this emerging country.
- Practical concept:
  
  o Different from the conventional training methods in the Vietnamese mining industry, training methods in Germany are highly participatory. Furthermore, they motivate participants to change their attitude and encourage their willingness to exchange and promote their ideas, and to create renovation. In addition to the training methods’ advantages, transference of technology and knowledge, and financial incentives can drive risk management’s effectiveness to better goals. Thus, the concepts, structures and methods of training courses in the Vietnamese mining industry should be changed in order to achieve better results in dealing with technical risks.

**Structure of the dissertation**

The dissertation is written in 6 parts, with supplementary parts such as the preface, appendix and references.

In the introduction, in addition to reasons for study, purposes and objectives of the research, the theoretical and practical concepts of the research and study methods are given. Anticipated results of the research are also listed.

In part 1: Overview of risk management and technical risk management – discussions on two main points: (1) risk management as a management function; and (2) technical risk management. Definitions of the terms risk management and technical risk management are given in this part. Risk management is also emphasized as a part of strategic management.

In part 2: The risk management process and risk management system in mining industry – the risk management process and risk and chance management system in the German mining industry are mentioned. The basic steps of identification, assessment and measurement to cope with risks and take advantages of chances are explained, regarding technical (T), organizational (O) and people (P) measurement.

The case study of the research is described in part 3: Case study – the Vietnamese coal mining industry: state-of-the-art in risk management. This comes after the brief introduction to the Vietnamese coal mining industry. The strategy of the Vietnamese
coal mining industry is also reported in different levels of corporate, companies and general strategy of safety. From this background, challenges in risk management can be realized.

The transference of the risk management system from German hard coal industry to Southeast Asia, initially applied in some underground mines in Vietnam, is offered in part 4. The prerequisite(s) of a successful transference is mentioned in this chapter. The transference will be conducted at national, corporate and subsidiaries levels.

In part 5, the results of the transference and other requisites for successful implementation are discussed. The results of transference are related to Vinacomin. For the effectiveness of the transference, there are two groups of requisites that are discussed: (1) economic and (2) cultural requisites.

Conclusion and further study are offered in the next part of the dissertation. Finally, there are the references which are grouped by 3 categories: (1) authorities, organizations and corporations (and other subsidiaries); (2) authors; (3) official websites of organizations and corporations.

**Research methods**

1. To identify the goal of the study, research objectives and the main duties of the dissertation, a **systematic** method is used to review literature on risks, technical risks, risk management and technical risk management in Germany and in Vietnam.

2. **Classification** is implemented for the terms of risk, risk management and technical risk management.

3. For recommendations of transference to Southeast Asian countries, it is required to conduct a **comparison** of some basic aspects, such as training and communication behaviour and other socio-cultural features.

4. The transference of the risk management system will be implemented in different companies; thus, **statistical methods** should be used for statistic data processing after the use of an **observation** method for the field research.
5. **Experiments** are undertaken in different mines in Vietnam to show the results of transference of risk management system, through which advantages, disadvantages and requisites can be presented.

6. **Experts’ consultation** is used in discussion about the state-of-the-art of risk management in collieries and in safety programs in Southeast Asia.

**Contributions of the dissertation**

1. Apart from an overview of risk management and technical risk management, and the implementation of the risk management system in the German coal mining industry, transference of German risk management system to the Vietnamese mining industry and other Southeast Asia countries was suggested, with the advantages and other requisites for a successful implementation. The transference is conducted through a multi-level approach.

2. Some information from the dissertation was published and/or presented in English at different international conferences in European countries (Germany and Poland) and Southeast Asian countries (Vietnam, Malaysia and Thailand) in order to introduce the transference. In Vietnam, publications and presentations were made at conferences for national safety programs, in which the results of the dissertation could be exchanged with other South East Asian participants. Further presentations were made at different domestic and international conferences, and workshops with the participations of scientists, mining experts and the coal industry authorities.

3. Some papers about risk tools in the risk management system of RAG, motivation and capacity in risk management, and participatory training methods have been published in Vietnamese bulletins, journals, and conference proceedings of the mining industry. From this approach, the coal mining community in Vietnam can obtain some knowledge and exchange ideas to build capacity in safety and risk management.
1 Overview of risk management and technical risk management

1.1 Prologue

When a child wants to cross the road he must look around to make sure that he will reach the other side safely. Similarly, when a company sets up projects, the managers should set up strategies to ensure that they can reach the objectives, forecasting potential setbacks that could hinder the company’s progress. Risk management, thus, can be an effective tool to secure success.


The terms risk and uncertainty are interchangeable. “Risks are an incidental problem... [which] must be either eliminated or denied and reinterpreted” as proposed by Beck (1986). Much older than this definition, F. Knight, as Branscomb et al. quoted in their publication in 2000, in his classic volume Risk and Uncertainty stated “uncertainty must be taken in a sense radically distinct from the familiar notion of risk, from which it has never properly been separated... “[A] measurable uncertainty, or “risk” proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all. We shall accordingly restrict the term “uncertainty” to cases of the non-quantitative type.”

As A. Greene (2000) quoted in his paper, the Royal Society (1983), viewed risk as the probability “...that a particular adverse event occurs during a stated period of

38 L. Genesove (2010), Occupational health hazards in mining and metallurgical work, Presentation at the Mining health and safety conference, Ontario, Canada, April 2010
40 L.M. Branscomb et al. (2000), Managing technical risk: Understanding sector decision making on early stage technology-based projects, Report for Advanced Technology Program, April 2010
41 A. Greene (2000), A process approach to project risk management, Loughborough University
time, or results from a particular challenge”. The Royal Society also stated that “as a probability in the sense of statistical theory risk obeys all the formal laws of combining probabilities”. The problem with statistical theory is that it is only a guess, or an approximation of what is to occur. There is no quantitative analysis involved with any statistical probability; hence, the use of the term “probability”; which is defined in Collins Concise English dictionary as “a measure or estimate of the degree of confidence one may have in the occurrence of an event, measured on a scale from zero (impossibility) to one (certainty)”\(^43\).

Smith (1999)\(^44\) defined risk as a decision expressed by a range of possible outcomes with attached probabilities. When there is a range of possible outcomes but no assumed probabilities, there is only uncertainty\(^45\).

Hertz & Thomas (1984)\(^46\) have suggested that “... risk means uncertainty and the results of uncertainty... risk refers result of uncertainty... risk refers to a lack of predictability about problem structure, outcomes or consequences in a decision or planning situation”. The problem with risk management is that it concerns events that have yet to transpire, which are in turn dependent upon events which may not be foreseen at the time of prediction. To truly predict a hazard, an encompassing holistic view of the situation is required which will never be totally achievable, even in laboratory conditions.

The Royal Society defined hazard as a situation which could lead to harm\(^47\). It is the realization that a situation may induce “harm” that inspires the recognition of risk in association with the hazard. It can be postulated that risk is the philosophy concerned with the understanding of the nature of harm associated with the hazard.

http://royalsociety.org/about-us: The Royal Society is a fellowship of the world’s most eminent scientists and is the oldest scientific academy in continuous existence. Today there are approximately 1500 Fellows and Foreign Members. The Society has three roles: it is the UK Academy of Science promoting the natural and applied sciences, a learned society, and a funding agency. As a learned society, the Society published mine peer-reviewed journals, including Philosophical Transactions of the Royal Society, the world’s oldest scientific title (author’s note).

\(^{43}\) http://www.collinsdictionary.com/dictionary/english/probability


\(^{45}\) A. Green (2000)


\(^{47}\) The Royal Society (1983)
According to A. Greene’s opinion, “for a risk to exist there must be a hazard”. A hazard is a source of potential harm or a situation with a potential to cause loss. The perception of hazards is entirely subjective. It is the way in which we feel threatened by circumstance and in turn the opinion we develop by association with the threat or hazard.

Adams (1995) said that “everyone is a true risk ‘expert’”, as people gain this experience from everyday activities. The difference between scientific perception and non-scientific perception is that the scientist will quantify the risks and rely on scientific analytical paradigms to prescribe the method of interpretation while the layperson will rely on experience and intuition.

Another definition was given in the Risk Management Guideline (New South Wales Treasury, 2004), which stated that “risk is the possibility that an expected outcome is not achieved or is replaced by another, or that an unforeseen event occurs. This broad view of risk includes both uncertainty due to future events and the consequences of limited knowledge, information or experience. It is measured in terms of consequences and likelihood”.

According to American managers E.L. Melnick and B. Everitt (2008), risk can normally be defined as the probability that a substance or situation will produce harm under specified conditions, and a combination of two factors:

- The probability that an adverse event will occur
- The consequences of the adverse event

Similarly, in the risk management handbook for the Australian mining industry defined risk as “the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood”.

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48 A. Green (2000), p.6
49 Australian Department of mineral resources (1997)
51 Official website of New South Wales Treasury (NSW Treasury) http://www.treasury.nsw.gov.au/: NSW Treasury was established in April 1824 and is the oldest continuing government agency in Australia. It is a Principal Department as defined by the Public Sector Employment and Management Act 2002. The NSW Treasury advises the Treasurer and the NSW Government on state financial management policy and reporting, and on economic conditions and issues.
52 New South Wales Treasury (2004), Risk Management Guidelines, p.8
Through this understanding, J.C. Chicken and Posner (1998) calculated:

\[
\text{Risk} = \text{Hazard} \times \text{Exposure}
\]  

(1-1)

And other authors such as V. Hagebölling (2009) stated:

\[
\text{Risk} = \text{Probability} \times \text{Damage}
\]  

(1-2)

In the handbook of the RAG Aktiengesellschaft (RAG), “one risk is caused by an event or circumstance negative deviation from a target which has been planned under the influence of uncertainty or decided”. Therefore, chance is defined as an event with positive deviation from a target which has been planned under the influence of uncertainty or decided. And different from other conceptions of risk and risk management from other countries or mining industries, the RAG manages not only risks but also chances, thus, they can take advantage from chances (opportunities). This is also one of the reasons for the author’s choice of the “German style” of risk management for Southeast Asian coal mining industry.

After some catastrophes at the end of 2010 such as the Gulf of Mexico and Yellow Sea oil spills, and serious accidents such as the trapped miners in Chile, and CH₄ explosion in New Zealand people can realize that the mining industry is a risky business. Hence, it is reasonable to establish a better concept of risk. According to the author’s idea, risk can be considered all the behaviors or actions (from a subjective or an objective side) which can probably threaten the sustainable development of our planet, our countries, our environment, our communities or our companies. This definition is broader than other definitions, as it covers all...

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54 Australian Department of mineral resources (1997), p.5
56 V. Hagebölling (2009), Technisches Risikomanagement, p.37, TÜV Media GmbH, TÜV Rheinland Group, Köln 2009
57 RAG Aktiengesellschaft (2008), RAG KR 06/08 “Risikomanagement”, p.6
58 RAG Aktiengesellschaft (2008)
60 The Guardian, China's worst-ever oil spill threatens wildlife as volunteers assist in clean-up (http://www.guardian.co.uk/environment/2010/jul/21/china-oil-spill-disaster-wildlife)
61 Reuters, Chilean miners rescued after 69 days underground (http://www.reuters.com/article/2010/10/13/us-chile-miners-idUSN0925972620101013)
62 British Broadcasting Corporation (BBC), New Zealand Pike River mine blast firm in receivership (http://www.bbc.co.uk/news/world-asia-pacific-11980604)
activities in different fields of not only the mining industry and relates to long term consequences.

However, there is no economic development without compromise, therefore, risk management is growing in parallel with and is based on objectives in that development.

To a particular company, loss or damage affect the business results depending on the: (1) duration of incidents and accidents; (2) duration of recovery from incidents and accidents. The amount of loss and damage depends on how the company deals with risks in each process. Incidents or accidents might happen independently from our expectations, however if we are prepared to deal with them then we can minimize losses and damages. Since no one can confirm that there is no risk in the company, from the company’s point of view, loss and damage should not be considered synonyms of risk. Rather, risks are causes which can lead to loss or damage (negative results). For instance, an incident in a mine which causes no fatalities and no damage to equipment can therefore result in better prevention methods.

Hence, to mining companies - in the author’s point of view - risk is an event or an action which occurs unexpectedly or unpredictably to people/companies and causes negative influence.

From the 2nd definition, in general terms, there are two methods of dealing with risks:

(1) Methods which prevent unusual events from occurring (after they are identified). Nobody can predict the future completely, but by making use of statistical data and experience, the development and the categorization from low to high (or downgrading) of threats can be estimated.

(2) Methods which prevent negative consequences from occurring. Risks can be controlled and/or treated. Both scope of damage and level of loss can be minimized. Hence, events could happen but the consequences might be insignificant.

Risks can be divided into two main categories, internal and external risks.
External risks are rooted in various factors, which can impact the overall economy and therefore, industries’ and firms’ strategies. These factors will be presented as conditions of risk management’s transference in the following chapter.

Internal risks are formed inside companies and can occur at any field from the beginning of the process (strategy and planning) to the end (distribution). They are caused mostly by direct and indirect resources which are classically grouped as: (1) personal resources (2) organizational competence and (3) financial and material resources.

By the definition above, risks can never be removed. The best way for treating risks is to manage them effectively.

1.2 Risk management as a management function

1.2.1 Definition of risk management and risk management procedure

The Casualty Actuarial Society Committee\(^63\) on enterprise risk management has adopted the following definition of risk management: “[Risk management] is the discipline by which an organization in any industry assesses, controls, exploits, finances, and monitors risks from all sources for the purpose of increasing the organization’s short- and long-term value to its stakeholders”\(^64\).

Risk management provides a structured way of identifying and analyzing potential risks, and devising and implementing responses. These responses generally draw on strategies of risk prevention, risk transfer, impact mitigation or risk acceptance.

The steps of the risk management process are illustrated in Figure 1.1\(^65\).

However, a process of risk management without the aspect of risk communication is not likely to be effective because it secures that the flow of information run fluently both top-down and bottom-up, and initiates to achieve the company’s target\(^66\).

\(^{63}\) http://causualtyactuarialsociety.com/about: The Casual Actuarial Society is a professional organization whose purpose is the advancement of the body of knowledge of actuarial science applied to property, casualty and similar risk exposure

\(^{64}\) Casualty Actuarial Society Enterprise Risk Management Committee (2003), *Overview of Enterprise Risk Management*

\(^{65}\) Casualty Actuarial Society Enterprise Risk Management Committee (2003)

Figure 1.1   Risk management process steps  
(Adapted from Overview of Enterprise Risk management)

**Establish context**: This step normally includes external, internal and risk management contexts:

- The external context starts with a definition of the relationship of the enterprise with its environment including identification of the enterprise’s strengths, weaknesses, opportunities, and threats (similar to a “SWOT analysis”\(^\text{67}\)).

- The internal context starts with an understanding of the overall objectives of the enterprise, its strategies for achieving those objectives, and its key performance indicators. It also includes the organization’s oversight and governance structure.

- The risk management context identifies the risk categories relevant to the enterprise and the degree of coordination throughout the organization, including the adoption of common risk metrics.

**Identify Risks**: This step involves documenting the conditions and events (including “extreme events”) that represent material threats to the company’s achievement of its objectives.

**Analyze/Quantify Risks**: This step involves calibrating and, wherever possible, creating probability distributions of outcomes for each risk. This step provides necessary input for subsequent steps, such as integrating and prioritizing risks.

Analysis techniques range along a spectrum of qualitative to quantitative, with sensitivity analysis, scenario analysis, and/or simulation analysis applied where appropriate.

Integrate Risks: This step involves aggregating all risk distributions, reflecting correlations and effects, and expressing the results in terms of the impact on the enterprise’s key performance indicators (i.e., the “aggregate risk profile”).

Assess/Prioritize Risks: This step involves determining the contribution of each risk to the aggregate risk profile and prioritizing accordingly, so that decisions can be made as to the appropriate treatment.

Treat/Exploit Risks: This step encompasses a number of different strategies, including the decision to avoid, retain (and finance), reduce, transfer, or exploit risk. For hazard risks, the prevalent transfer mechanism has been the insurance market. Alternative risk transfer (ART) markets have developed from these with a goal of striking a balance between risk retention and risk transfer.

Monitor & Review: This step involves continual gauging of the risk environment and the performance of the risk management strategies. It also provides a context for considering risk that is scalable over a period of time. The results of the ongoing reviews are fed back into the context and the cycle repeats.

Australia is one of the most important coal exporters in the world and has established a handbook on risk management in mining. According to the Risk Management Guideline of New South Wales Treasury\textsuperscript{68}, the process of risk management is followed by the steps below (Figure 1.2):

In this process, the steps are defined as follows:

- Proposal familiarisation:
  - Define proposal/project scope and objectives;
  - Identify criteria for assessing the proposal or project; and
  - Define the key elements and issues.
- Risk analysis:

\textsuperscript{68} New South Wales Treasury (2004), p. 12
Identify all risks that might impact the proposal or project; It is worth noting the Pareto rule (80/20) in this handbook, which states that most effects are due to a few causes\(^\text{69}\).

Assess the potential likelihood and consequences of each risk;

Screen risks to discard the minor risks having low impact and low likelihood of occurrence; and

Identify moderate and major risks that require management attention.

- Risk response planning:

  - Identify the feasible responses to moderate and major risks. Risk responses will include: (1) risk prevention, (2) impact mitigation, (3) risk transfer, (4) risk acceptance and (5) selecting the best response;

  - Develop risk action schedules for major risks; and

  - Develop management measures for moderate risks.

- Reporting:

  - For major undertakings, prepare a risk management plan; and

  - For other projects, compile and collate risk action schedules and measures.

- Implementing:

  - Implement the action schedules and management measures;

  - Monitor the implementation; and

  - Periodically review risks and evaluate the need for additional risk management.

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\(^{69}\) Australian Department of mineral resources (1997), p. 76
The main output from the process is a series of consequences, which spreads from the possibilities of risk to the activities to deal with risk and their implementation.

Malaysia has published guidelines for hazard identification, risk assessment and risk control (HIRARC). In this document, **hazard identification** means the identification of undesired events that lead to the materialization of the hazard and the mechanism by which those undesired events could occur. **Risk** means a combination of the likelihood of an occurrence of a hazardous event within a specified period or in specified circumstances and the severity of injury or damage to the health of people, property, environment or any combination of these caused by the event. **Risk assessment** means the process of evaluating the risks to safety and health arising from hazards at work. **Risk management** means the total procedure associated with identifying a hazard, assessing the risk, putting control measures into place, and reviewing the outcomes.\(^\text{70}\)

Consulting companies in Germany, such as Schleupen AG\(^\text{71}\), offer risk management software programs with the following risk management procedure, which contains 4 (or 5) basic steps:

- Identification;
- Assessment (measure);
- Analysis;
- Treatment; and
- Report.\(^\text{72}\)

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\(^{\text{70}}\) Department of Occupational Safety and Health, Ministry of Human Resources, Malaysia (2008) *Guidelines for hazard identification, risk assessment and risk control (HIRAC)*

\(^{\text{71}}\) www.schleupen.de: Schleupen AG is a provider of intelligent IT solutions. Core competencies of Schleupen AG are energy and water industries and cross-industry risk management, IT infrastructure and Enterprise Content Management distribution. As regards energy industries, Schleupen AG is one of the few vendors to offer a coherent solution. The company also offers a chance to R2C- risk to chance management system, which is used by medium-size companies as well as publicly traded companies and international operating groups. In the mining and minerals industry, RAG is also a case study of Schleupen AG (author’s note).

\(^{\text{72}}\) Schleupen AG, R2C- risk to chance – *Die flexible Software-Lösung für das Risiko- und Chancenmanagement*
Moreover, risk management is integrated into other management functions\textsuperscript{73}.

In general, risk management is neither a quick and easy win nor a one-off activity. The main objective of risk management is to identify and analyze risks and manage their consequences. Assessing risk dangers continuously helps us to find plausible methods of treating risks.

Organizationally, a defensive stance is taken towards risks, it is viewed as a situation to be minimized or avoided. Increasingly, organizations have come to recognize the value or the positive potentials of risk, while avoidance remains a legitimate strategy for dealing with risks.

\textsuperscript{73} RAG Aktiengesellschaft - RAG (2009), p.6
\textsuperscript{74} RAG Aktiengesellschaft (2011), \textit{Risikomanagement(RCM) – Handbuch der RAG Aktiengesellschaft}, p.6
There are plenty of reasons for a shift to this point of view. Over time, companies have become more familiar with and more capable of managing risks and therefore being able to cope with them. They develop expertise in managing those risks because of familiarity as well as confidence in the organization’s abilities. Understanding of risks and having plausible treatment of risks can provide a competitive advantage.

Similarly, it is considered that there is a close connection between losses from risks and associated benefits: business fields with high potential profit can be threatened by high potential risk. Risk does not mean “bad” or “terrible”, because of the existence of risk, managers are able to create protection from risk and predict the losses and damages as well as seizing chances and opportunities. A plausible strategy with predictive measures can prevent the company from exposing threats.

This philosophy of risk management in Germany has been developed into Risk and Chance management in many firms and mining companies are not an exception. According to Romeike, about one third of DAX-100 companies use risk and chance management. Other countries that well developed in the mining industries have gained experience in risk management can overlook chances, of which they can take advantage. This is the main reason why this dissertation has chosen to apply German risk management to the Vietnamese mining industry.

Risk management can be considered a special management function, which brings together all duties of business management in order to identify risks, and to control, prevent and minimize all damages, losses and negative consequences from risks.

Although there are many risk management terms such as operational risk management, and enterprise risk management, in this thesis, the term “risk management” covers all activities of the risk management circle.

In essence, risk management is considered the derivation crisis management. According to A. Schuy, as quoted V. Hagebölling: crisis management refers to only

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75 RAG (2009)
76 Official website of German Stock Exchange Groups http://www.dax-indices.com/: German Stock Exchange Index
77 F. Romeike (2002), p.13
issues which already exist, risk management also refers to uncertain issues\textsuperscript{78, 79}. Thus, risk management is an umbrella term for crisis management\textsuperscript{80}.

Developing from this concept risk management should be considered as “\textit{a special function in business management [which] integrates other functions (personnel management, financial management, production management etc.), containing an aggregation of identification, protection and reduction of loss, damages and negative influences from risks}”\textsuperscript{81} as risks can happen within every procedure and every year of a business, from purchasing to production and sale, from human resource to machinery, and from financial borrowing and lending.

Implementing plausible risk management is therefore a process of contingency with reasonable expenses, dealing with risks in fields of business. Consequently, it can create long-term advantages in terms of competition. In other words, companies should adopt risk management system as part of their business strategy.

\subsection*{1.2.2 Risk management as a part of strategic management}

In large mining groups such as RAG Aktiengesellschaft (Germany) or BHP Billiton (Australia), managers admit that risk is inherent to business\textsuperscript{82, 83}. They are aware of risk and its manifestation in many forms and understand its potential impact to health and safety, environment, community, reputation, and to the regulatory, operational, market and financial performance of their groups.

For the development of any company, it is necessary to understand and manage risks caused by internal and external factors. Stakeholders are thus provided with greater certainty and confidence of success and sustainable development.

Successful risk management can therefore represent a competitive advantage.

\textsuperscript{78} V. Hagebölling (2009), p. 29
\textsuperscript{79} A. Schuy (1989), \textit{Risikomanagement, eine theoretische Analyse zum Risiko und Risikowirkungsprozeß als Grundlage für ein risikoorientiertes Management unter besonderer Berücksichtigung des Marketing}, Frankfurt am Main
\textsuperscript{80} V. Hagebölling (2009), p.21
\textsuperscript{81} J. Kretschmann, N. Nguyen (2011b), \textit{Managing risks in mining: Safety for social sustainable development}, The 5\textsuperscript{th} international workshop and conference on earth resources technology (5\textsuperscript{th} IWCERT), Malaysia, May 2011
\textsuperscript{82} Australian Government, Department of Resources Energy and Tourism (2008), \textit{Risk assessment and management}, p.8
\textsuperscript{83} RAG Aktiengesellschaft (2010), \textit{Nachhaltiger Bergbau}, Präsentation
Risk management should begin at the strategic planning stage of a proposed project or program and continue throughout its circle, as suggested in Risk Management Guidelines of New South Wales\textsuperscript{84}, and by F. Romeike\textsuperscript{85}.

In building a strategy, according to M. Porter (1980)\textsuperscript{86}, managers should take an overview of the advantages and disadvantages of external and internal factors’. Opportunities and threats from external factors (such as economic, political, and social factors), and strengths and weaknesses from internal factors (human resources, purchasing, marketing etc.) are analyzed (SWOT analysis). From these information, risks and chances can be also better understood.

Following these ideas, risk management can be seen as a part of strategic management. It should be one of the subjects mentioned in a company’s strategy. Devising adequate treatment for risks can help a company reduce losses due to risks instead of depending on (sometimes unrealistic evaluated) opportunities.

First Chance Prevention\textsuperscript{87} has been the threshold of both strategic ideas and tactic activities, in order to avoid incidents and minimize damages. For instance, prevention is the duty both of the managers based on the safety vision and guidelines of the company, and the workers who are responsible in their workplaces\textsuperscript{88}. Instructions about all the proper risks are updated and revised regularly. Frequent brief meetings are conducted before working, in which the miners are encouraged to exchange their ideas about improvement of safety. To reach these targets, managers must possess knowledge and leadership qualities\textsuperscript{89}, and safety regulations and standards must be taught, understood, discussed, reviewed and upgraded\textsuperscript{90}, etc.

These things are crucial to raise the awareness of risk management in mining industries. Emerging mining countries, where the economic development is based on

\textsuperscript{84} New South Wales Treasury (2004)  
\textsuperscript{85} F. Romeike (2002)  
\textsuperscript{86} M. Porter (1980), 1998  
\textsuperscript{87} J. Kretschmann, N. Nguyen (2011a)  
\textsuperscript{88} W. Hermülheim, R. Schumachers, C. Dauber (2009), \textit{Occupational health and safety and hazard control in coal mines}, Mining reporter online, Glückauf mining reporter, Vol 1, 2009  
\textsuperscript{89} C. Dauber (2007), \textit{Mine safety and risk assessment in German Coal Mines} – Deutsche Steinkohle AG, Tripartite Workshop on Risk Assessment and Risk Management in Coal Mines. International Labor Organization, Beijing, China, April 2007  
\textsuperscript{90} J. Kretschmann, N. Nguyen (2010)
the development of the excavation of mineral resources\textsuperscript{91,92}, should also understand the role of prevention in order to manage risks successfully. High fatality rates in the coal mining industry in China – especially in privately-owned mines\textsuperscript{93} - and Vietnam\textsuperscript{94} are evidences of the negative effects of unmanaged risks in extractive industries.

Long-term activities related to risk management such as internal education and training, and enhancing risk management systems will bring more benefits to companies\textsuperscript{95}. According to a survey quoted by Risk and Insurance Management Society, Inc (2009)\textsuperscript{96}, companies with a strategic approach were more likely to increase their investment in risk management in 2009. The risk management program is adding value even during tough economic times\textsuperscript{97}. The advantages a company can gain through strategic risk management are: (1) Improving the capability of identifying and accessing risks; (2) Increasing ability to meet corporate strategic goals by ensuring risks are explicitly considered in business decisions; and (3) Increasing management and business-unit accountability\textsuperscript{98}.

Risk management could not come into effect unless it becomes a system which especially focuses on cross-divisional management functions (Figure 1.4). This system will be described in detail in the next part (Risk management processes and the Risk management system in the mining industry).

\textsuperscript{91} Official website of Deloitte:  
http://www.deloitte.com/assets/Dcom-Canada/Local\%20Assets/Documents/EandR/Mining/ca_en_energy_China_and_mining_020411.pdf,  
Asia’s expanding influence on the global mining industry

\textsuperscript{92} Official website of Industrial Review of Vietnam (ISSN 1859 – 3992) :  
(http://www.tapchicongnghiep.vn/News/channel/1/News/357/14762/Chitiet.html) Coal exports achieved 1,549 million US dollars in 2010, ranked the 11\textsuperscript{th} of 18 goods which have exports over 1 billion US dollars (Vietnamese)

\textsuperscript{93} CLSA Asia – Pacific markets (2010), Appendix: Coal-mining accidents in China, p.56

\textsuperscript{94} Ministry of Labor, Invalid and Social Affairs, Annual reports on national accidents (from 2006 – 2010), Synthesized data (Vietnamese)

\textsuperscript{95} C. Dauber (2007)

\textsuperscript{96} Risk and Insurance Management Society, Inc. (RIMS)  
http://www.rims.org/aboutRIMS/Pages/MissionandDescription.aspx: RIMS is a global not-for-profit organization representing more than 3,500 industrial, service, nonprofit, charitable and government entities throughout the world. Founded in 1950, RIMS brings networking, professional development and education opportunities to its membership of more than 10,000 risk management professionals who operate in more than 120 countries.

\textsuperscript{97} Risk and Insurance Management Society, Inc (2009), Excellence inRisk management VI, Strategic risk management in Practice, p. 11

\textsuperscript{98} Risk and Insurance Management Society, Inc (2009)
Strategically, in recent years risk management has been developing from damage management in legal frame to holistic risk management in entrepreneurial scale (Figure 1.5).

**Figure 1.5 Development from damage management to holistic risk management**

(Adapted from Arbeitskreis Externe und Interne Überwachung der Unternehmung (AKEIÜ) der Schmalenbach-Gesellschaft für Betriebs-Wirtschaft e.V. Köln, 2010)

Damage management ensures legal compliance with other regulations such as occupational safety, the investigation of significant damages and using insurance for compensation. Companies are aware of the existence of certain risks and dangers, but they focused on the avoidance of damages. However, when there is a legal framework such as the German law called KontraG, risk management has to be

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developed into a system which includes monitoring, evaluating, reporting, etc\textsuperscript{100}. In an entrepreneurial aspect, risk management contains negative consequences (risks) and positive consequences (chances). The most important improvement of the management is the aggregation of individual risks into overall ones, using informative support in decision making. This leads to the highest level of risk management, called holistic risk management with complete integration into existing management tools. Risks are treated both individually and in relationship to others in an overall portfolio\textsuperscript{101}.

1.3 Technical risk management

1.3.1 Technical risk

"Technical" in British English, as defined by the Cambridge Dictionaries Online, "relates to the knowledge, machines or methods used in science and industry, or to the knowledge and methods of a particular subject or job, or relates to practical skills and methods that are used in a particular activity"\textsuperscript{102}. In American English, "technical" means "involving or needing special skills or knowledge, especially in science or engineering (the design and building of machines, equipments and structures)"\textsuperscript{103}.

Generally, there is no common definition for technical risks. For instance, in construction, technical risks are considered the unforeseen conditions in design, construction, operation and maintenance\textsuperscript{104}. Although mentioned in other fields, such as "Guidelines of technical risk assessment"\textsuperscript{105}, and the "Overview of Enterprise Risk Management"\textsuperscript{106}, definitions of technical risks are not quite clear.

In the mining industry, technical problems come not only from machines or equipment but also from geological conditions. Engineering geology and hydrological geology affect the excavation, performance of props, ventilation and

\textsuperscript{100} W. Gleißner, B. Mott (2008), Risk management auf dem Prüfstand – Nutzen, Qualität und Herausforderungen in der Zukunft, ZRFG 2/2008

\textsuperscript{101} Arbeitskreis Extern und Interne Überwachung der Unternehmung (AKEIÜ) der Schmalenbach-Gesellschaft für Betriebs-wirtschaft e.V. Köln (2010)

\textsuperscript{102} http://dictionary.cambridge.org/dictionary/british/technical

\textsuperscript{103} http://dictionary.cambridge.org/dictionary/american-english/technical

\textsuperscript{104} K. Souflis, G. Vitouslas, PPP – PFI technical issues

\textsuperscript{105} J. O’Neill et al. (2007), Technical risk assessment: a practitioner’s guide, General document of the Defence Science and Technology Organization, Australia

\textsuperscript{106} Casualty Actuarial Society Enterprise Risk Management Committee (2003)
water control. Understanding of geological conditions helps to prevent incidents like chamber blasts, water inrush, gas explosions or asphyxiation.

According to J. McGill (2005), technical mining risks can relate to any of the technical requirements of mining\textsuperscript{107}. According to the ideas of Raftery (1994), who was quoted in the research of McGill, technical risks will be prevalent in all decisions relating to mining, rock engineering, engineering, and metallurgy, etc. In an attempt to identify a unit of measurement for technical risk, acceptability criteria such as “time taken for failure” or “number of fatalities” may be considered. Most often, risk is also calibrated in financial terms\textsuperscript{108}.

In documents such as the Australian handbook of risk management\textsuperscript{109} or according to authors G. Raymond and S. Grey (1997)\textsuperscript{110}, technical risks refer to hazards, and therefore, the study of technical risks is the study of hazards.

As quoted by L. M. Branscomb et al., the quantification of technical risks is as much an art as it is a science. The elements of a technical risk are not easily characterized, became a real technical risk involves a forecast of how people conduct experiments, interpret results, and apply them to real situations. The elements of a technical risk are chaotic, in that they are dependent on people and the environment, as well as the laws of science (some of which are known, and some of which are unknown). Beside of this, elements of technical risks are not independent of one another. Actions to understand and mitigate risks are interrelated through the laws of science, patterns of rational processes, and the personalities of people involved. Risk can be characterized as a probability of success but it is always a probability with a set of premises, an expected environment, and a pattern of response with a correlated expectation of success\textsuperscript{111}.

From those ideas, according to the author, technical risks can come from both external and internal factors. External factors are disasters and natural hazards which

\textsuperscript{107}J. E. McGill (2005), Technical risk assessment techniques in mineral resource management with special reference to the junior and small-scale mining sectors, p.52, University of Pretoria, Pretoria, May 2005
\textsuperscript{108}J.E. McGill (2005), p. 52
\textsuperscript{109}Australian Department of mineral resources (1997)
\textsuperscript{111}L.M. Branscomb et al. (2000)
impact the machines and equipment or the techniques used, and geological conditions. Internal factors can be classified by many categories, which refer to the concept of Mc Gill regarding the technical requirements of mining\textsuperscript{112}.

The complexity of geological conditions can cause risks in excavation. The research of Q.H. Phung et al. for example showed that the carelessness of workers working with unstable roof rocks caused chamber blasts and collapses\textsuperscript{113}. Chamber excavation is one of the technologies which limit the number of workers used and thus, reduces death tolls in underground excavation. However, fatal accidents regularly happened, hence Vinacomin decided to restrict this technology until 2005, when solutions could be found\textsuperscript{114}.

Figure 1.6 illustrates the classification of technical risks. However, categories of internal technical risks are interdependent.

![Figure 1.6 Classification of technical risks](image)

For instance, after a flood and due to fissures, water is accumulated. During the drilling, water inrush can occur if the situation is not well managed (categories:

\textsuperscript{112}J. E. Mc Gill (2005)
\textsuperscript{113}Q.H. Phung et al. (2010)
\textsuperscript{114}Q.H. Phung et al. (2010)
geological conditions and information). Another example: from 2005 to 2009 gas explosions in Vinacomin happened mostly at pre-production coal faces, where there was a dense accumulation of methane gas. Explosions occurred on Mondays (twice) in two coal mines, which were classified as having medium and below-medium density levels of methane gas. Poor ventilation during weekends and spark fire from electronic equipments were these explosions, which had not been evaluated as risks. Investigations proved that the job was not in compliance with the technical rules and that worksite authorities made the mistake of allowing miners to work underground at the same time as methane gas measuring teams\textsuperscript{115} (categories: information, organization and human behavior).

From those facts, it can be stated that in addition to the technical issues themselves, technical risks in mining industry also come from geological conditions, mining conditions and human behavior.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure1.7.png}
\caption{Main impact factors to technical risks in coal mining industry}
\end{figure}

\subsection*{1.3.2 Technical risk management}

According to Hagebölling (2002), technical risk management is a useful category of risk management to deal mainly with the production site’s issues, the installed equipment and production facilities, the technology required to operate the infrastructure, repair time, organizational processes etc\textsuperscript{116,117}. One of the main tasks of technical risk management in general is to record the risk situation using risk analysis. The context of analysis is the corporate policy or the legal requirements, and subsequently necessary measures to optimize the risk situation, adequate to initiate and control the implementation schedule, evaluation and documentation of

\begin{itemize}
\item\textsuperscript{115} Q.H. Phung et al. (2010)
\item\textsuperscript{116} V. Hagebölling, (2002), Safety Engineering und Versicherungen? – Technische Risikobetrachtung und die Auswirkung durch das KontraG Gesetz, 4. DMT SommerForum, DMT GmbH
\item\textsuperscript{117} V. Hagebölling, (2005), Erfassung, Reduzierung und Kontrolle des Betriebsunterbrechungsrisikos, Erfahrungsbericht
\end{itemize}
the risk management system\textsuperscript{118}. This is also mentioned as a duty of risk management in the “Risk management handbook for the mining industry of Australia”\textsuperscript{119}.

According to Hulett (2000), technical risk management can be considered as technical performance measurement (TPM), which includes the following steps: (1) Identify key technical goals or targets to be made through a project or business; (2) Set the targets in the schedule, usually at key milestones; (3) Measure technical achievements; and (4) Compare measured achievements to the technical baseline\textsuperscript{120}.

As the study of technical risk management relates to the study of hazard, there should be a consideration of related terms like Hazard and Operability (HazOp) Study and Machinery Hazard Identification (MHI). According to the Australian risk handbook the definition HazOp Study is “a technique for identifying hazards and potential operability problems, in simple or complex equipment, processes or plans, in which a team uses “keywords” to prompt recognition of deviations from normal operating conditions which could have adverse effects on safety, environment, operability or performance”\textsuperscript{121}. MHI is “a technique for identifying hazards inherent in the design of a machine, making use of “keywords” to prompt recognition of possible accident scenarios arising from machinery malfunction or mal-operation, including those triggered by poor design or equipment failure, as well as inappropriate human actions in relation to the machine”\textsuperscript{122}.

The purpose of hazard studies, according to G. Raymond and S. Grey\textsuperscript{123}, is to minimize hazardous activities and the chance of accidents and incidents and to minimize the effects of these accidents if they do occur. Hazard studies are a systematic checking process and do not replace good design and operation, including both hazard management and safety management systems.

\textsuperscript{118} V. Hagebölling (2009), p.32
\textsuperscript{119} Australian Department of mineral resources (1997), p.3
\textsuperscript{120} D. T. Hulett (2000), \textit{CPM – 500 Principles of Technical Management}, Lesson F: Project schedule risk analysis, IPMC 2002 Fall conference of Professional education program
\textsuperscript{121} Australian Department of mineral resources (1997), p.5
\textsuperscript{122} Australian Department of mineral resources (1997), p. 5
\textsuperscript{123} G. Raymond, S. Grey (1997)
According to W.D. Rudolph and C. Pachurka, technical risk management is solved by answering the following questions\textsuperscript{124}:

- a) Whether potential risks are assigned to the engineering environment; and
- b) what effect this has on the plant’s equipment,
- Which of these potential risks can generate actual threat,
- What protection goals are specially defined for the company,
- What the law requires in terms of technical risk management,
- Which international standards are used,
- What concerns the different stakeholders,
- What concerns the lenders,
- What added value is created by the technical risk management,
- What correlation exists between the technical risk management and safety at work, and
- To what extent is the potential of “risk assessment” in accordance with Labor Code used as part of risk analysis.

Also in the opinions of these authors, technical risk management and safety are inseparable. These areas have a large intersection with many similarities.

\textbf{Figure 1.8} \textit{Relationship between risk management and cost}  
(Adapted from Rudolph and Pachurka, 2009)

The author also agrees with the opinion of the inseparability of technical risk management and safety. Being cautious during production does not restrict productivity but helps reduce accident rates, and therefore, prevent the company from loss and damages\textsuperscript{125}. Safety competence plays an important part in the framework of risk management. It is also a cross-disciplinary area concerned with protecting the safety, health and welfare of the people engaged in work. The goal of all occupational safety and health programs, therefore, is to foster a safe working

\textsuperscript{124} W.D. Rudolph, C. Pachurka, (2009), \textit{Technisches Risikomanagement aus Sicht der Berufsgenossenschaft}, Technisches Risikomanagement, TÜV Media GmbH, TÜV Rheinland Group, Köln 2009
\textsuperscript{125} J. Kretschmann, N. Nguyen (2011b)
environment. The aim of occupational safety and health are to promote and maintain the highest degree of workers’ physical, mental and social well-being, that is to prevent risks resulting in dangers to health; to place and maintain the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, to adapt work to the man and each man to his job\textsuperscript{126}. Mining companies and stone excavation companies in Vietnam have a shortage of investment in occupational safety\textsuperscript{127}, therefore workers tend to look for jobs with higher income and safety standards instead of going into the mining industry\textsuperscript{128}. It might be argued that when a company invests a lot in safety programs, their short-term profits might be reduced. But the investment in safety increases other benefits, such as good image, smooth production, stable labor force and higher attractiveness to new laborers, etc\textsuperscript{129}. Managers should keep in mind that an effective risk management will minimize all kinds of losses.

According to Figure 1.7, control of technical risks should start from both geological conditions and human behavior. Geological conditions cannot be changed, but can be handled properly. An essential feature of technical risk management is human resource management, since humans’ awareness of their actions can play a major role in the production. These are the reasons why technical risk management in the Vietnamese coal mining industry should be integrated into other management functions and the adjustment of human attitudes towards safety at work.

\textsuperscript{126} Official website of International Labor Organization
\textsuperscript{127} Ministry of Labor, Invalid and Social Affairs, Annual reports on national accidents (from 2006 – 2010), Synthesized data (Vietnamese)
\textsuperscript{128} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2011a), Report of labor force and personal management in 2010, 2011 (Vietnamese)
\textsuperscript{129} J. Kretschmann, N. Nguyen (2011a)
2 The risk management process and the risk management system

2.1 The risk management process

How the German hard coal industry and other companies are dealing with risks is mentioned in this part, in order to provide a context for the transfer of risk management systems from Germany to the Southeast Asian coal mining industry.

According to the RAG Corporation risk management handbook (2009)\textsuperscript{130}, the risk- and chance - management process (RCM) is a control cycle:

\begin{itemize}
  \item Risk and chance Identification:
    \begin{itemize}
      \item Determination of the risk areas
      \item Identification of the key strategic and intensive risks
    \end{itemize}
  \item Risk and chance Assessment:
    \begin{itemize}
      \item Assessment of the damages and consequences from risks – Risk portfolio
      \item Prioritization for major/continuous risks and chances
    \end{itemize}
  \item Risk and chance Control:
    \begin{itemize}
      \item Prevention and reaction measures
      \item Internal Monitoring system
      \item Cost – Benefit analysis
      \item Action tracking
    \end{itemize}
  \item Risk and chance Aggregation:
    \begin{itemize}
      \item Statements about the distribution and correlation of risk and chance
      \item Determine the overall risk and chance
    \end{itemize}
  \item Risk and chance Report:
    \begin{itemize}
      \item External reporting
      \item Selected contents of the report to the Supervisory Board and Shareholders
    \end{itemize}
  \item Risk and chance Monitoring:
    \begin{itemize}
      \item Description of operational and organizational structure
      \item Metrics, indicators, thresholds
      \item Internal reporting
    \end{itemize}
\end{itemize}

Table 2.1 Organizational structure of the Risk and Chance Management Process
(Adapted from Risk management handbook of RAG Corporation)

2.1.1 Risk and chance identification

The major goal of Risk and Chance (RC) identification is early warning. According to the RC management process from the RCM handbook of RAG, the members of the RCM Steering Committee will determine employees who have competence in their areas for RC identification\textsuperscript{131}. As nobody can identify risks and chances alone,

\begin{itemize}
  \item RAG (2009), p.8
  \item RAG (2011), p.10
\end{itemize}
it is better to have a group of experts, people in charge and others to identify risks and chances. The RC identification must be fully covered in all areas, sources of dangers, harms and potential interferences of the company.

There are several techniques which can be used in RC identification which RAG also suggests in the handbook:

- Survey analysis;
- Document analysis;
- Organization analysis;
- Interviewing the employees;
- Workshops;
- Check lists;
- Observation; and
- Early warning indicators\textsuperscript{132}.

However, other techniques listed below are also available for identifying risks:

- Action error analysis;
- Failure mode and effects analysis (FMEA);
- Failure mode and effects criticality analysis (FMECA);
- Fault tree analysis (FTA);
- Hazard and operability studies (HazOp);
- Machinery hazard identification (MHI);
- Potential human error identification (PHEI);
- Rapid ranking;
- Workplace risk assessment and control (WRAC); and
- What – if? analysis\textsuperscript{133}.

The RC identification can be considered a significant step of RC management\textsuperscript{134}, as without it, no risk can be optimally and actively managed.

\textsuperscript{132} RAG (2011), p.10
\textsuperscript{133} Australian Department of mineral resources (1997), p.12
\textsuperscript{134} J. Kretschmann, N. Nguyen (2011b)
2.1.2 Risk and chance assessment

Risk and chance assessment can be considered as risk and chance evaluation. Assessment determines the scope (evaluation) in the form of a statement about the likelihood and impact from the identified RC (results from the first step)\(^\text{135}\).

In this step, important factors of occurrence probability (Eintrittswahrscheinlichkeit - EW) and impact (Auswirkung - AW) are calculated or estimated.

A risk can be seen as very low probability when the EW is less than 10%; low probability when the EW is from 10 to 30%; medium probability when the EW is from 30 to 60% and high probability if the EW is higher than 60%.

The impact of risk can be estimated by (1) Quantitative methods, (2) Qualitative methods (where the AW can be classified from “insignificant to “extremely high”), and (3) Text assessment (in case the AW cannot be predicted).

Based on different impact and scopes of business – consortium or subsidiary, classification of the AW can be in different amounts of money\(^\text{136}\).

In RAG, some tools are being used in the risk management system, such as the risk map, to illustrate the results of the assessment report about regarding risks (and chances) in companies\(^\text{137}\).

The risk map contains a list of risks sorted according to priority and a matrix with the likelihood and consequences of potential risks. Figure 2.2 is a detailed presentation of risks and risk description. A similar structure is used for chances.

Listed risks (and chances) are assessed in both likelihood and consequences, so that managers can calculate the damage of each risk and choose plausible methods of treatment. By likelihood and consequences, the risk matrix is divided into 3 different parts, which are labelled as insignificant (green), neutral (yellow) and dangerous (red). Like a traffic light, a risk map gives signals for managers to decide their behaviors regarding risks and chances. The advantage of this tool is that it is easy to

\(^{135}\) RAG (2011), p.12
\(^{136}\) RAG (2011), p. 13
\(^{137}\) RAG (2011), p.21
use with specific and clear descriptions/instructions for those in charge, and requires only simple equipment. This tool can be used for reports (for managers) or notice boards (for workers on-site).

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<th>Consequences AW (TEUR)</th>
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<td>80</td>
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<td>800</td>
<td>100</td>
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**Figure 2.2  Risk map model in German coal mining**  
(Adapted from RAG Handbook of risk management, 2011)

### 2.1.3 Risk and chance – Control/Measures

RAG quoted F. Romeike’s concept (2002) of using measures to avoid or to reduce risks, to pass risks to other parties and acceptable risks, which influence (the reduction of) the EW and/or the AW.

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139 F. Romeike (2002)

140 RAG (2011), p.15
According to F. Romeike, aside from the mentioned methods, mergers and acquisitions as well as effectiveness analysis are also subjects to risk management\textsuperscript{141}. Risk avoidance is usually understood as an abandonment of production or other activities to avoid the occurrence of all risks\textsuperscript{142}. However, this measure is extremely cautious and status quo orientated, as there are no opportunities in business operations without any risks, or in other words “no risk – no fun”\textsuperscript{143}.

Reduction of risk contains measures to reduce the EW of assessed losses (such as business interruption), or to reduce threats by human errors by creating an appropriate

\textsuperscript{141} F. Romeike (2002), p. 14

\textsuperscript{142} RAG (2011), p.15

\textsuperscript{143} J. Kretschmann, H. Ehnes (2011), \textit{Success by systematic safety: International experiences and concepts for small mine operations}, Society for Mining, Metallurgy and Exploration (SME) annual meeting, Denver, March 2011

Figure 2.3 Measures to deal with risks
(Adapted from F. Romeike, 2002)
internal control system, quality assurance system, preventive measures (fire protection, maintenance), and training, etc.\textsuperscript{144}.

Transfer of risks to other parties such as insurance companies or by contracts’ terms means also the companies decide which risks shall be acceptable\textsuperscript{145}.

J. Kretschmann (2008)\textsuperscript{146} suggested some further measures, one of which is risk mitigation. Risk mitigation involves implementing security measures in order to limit the occurrence of risks and therefore reduce capital loss.

According to Figure 2.3, non-identified risks will restrict the advantages of risk management.

\section*{2.2 The risk management system in the mining industry: theory and practice}

\subsection*{2.2.1 The risk management system}

Risk management, as defined in the previous part, is the aggregation of activities such as identification, analysis, assessment and treatment of risks. Therefore, these should not be isolated activities but implemented within a system for the long-term and in order to achieve better results.

From the Collins English Online dictionary, a system is “a group or combination of interrelated, interdependent, or interacting elements forming a collective entity”\textsuperscript{147}. A system, thus, must contain a variety of elements relations and their mutual impacts. The risk management system is a tool that supports the risk management process\textsuperscript{148}. §91 Section 1 of the German Law of Control and Transparency in companies (KontraG)\textsuperscript{149} states: “The board must take appropriate measures, in particular the installation of a monitoring system, so that developments which could endanger the survival of the company can be identified in good time.” Risk management systems in Germany, therefore, consist of an internal monitoring system, a controlling department and an early warning system.

\begin{thebibliography}{99}
\item Kretschmann (2008)
\item RAG (2011), p. 16
\item J. Kretschmann (2008), \textit{Vorlesung des Risikomanagements} an der RWTH Aachen
\item http://www.collinsdictionary.com/dictionary/english/system
\item V. Hagebölling (2009), p.20
\item The Law of Control and Transparency in Companies - Gesetz zur Kontrolle und Transparenz im Unternehmensbereich (KontraG), (1998), Stipulation on 1. May 1998
\end{thebibliography}
The risk management system of RAG (understood as a risk and chance management RCM) is an integral part of corporate governance based on the RAG and includes the following elements: internal monitoring system, warning system, risk and chance controlling; and compliance. Essential components of the organizational structure of RCM in RAG are the Risk Management Steering Committee and the Risk Management Officer.

The RCM of RAG is codified entirely by rules such as corporate governance, code of conduct, policies, procedures, manuals, etc. RAG established a monitoring system, thus the existence of risk trends can continue to be identified early (early warning system).

The internal monitoring system includes process-integrated monitoring measures/organizational security measures and controls (internal control system ICS; in German IKS), and monitoring measures independent of the process (internal auditing). Organizational security measures are taken to avoid mistakes. The tasks of the audit include the review and assessment of the effects of the early warning system and monitoring system.

The risk management system is designed to achieve early identification of key operational and strategic risks and chances and to analyze those risks. Its objective is to take timely action to avoid potential risks or at least to limit the amount of loss of potential risks and to take advantages from chances in the main areas of risk. Reports of risk and chance management are sent to members of the Board of Managers: RAG Foundation and Risk Chance Controlling. For the main risk areas, the Board of
Managers determines risk and chance management with the people in charge of departments, divisions and at company level in accordance with the applicable requirement. Ensuring the completeness and factual accuracy of the recognition of the principal risks and chances are the responsibilities of the Risk and Chance Management Steering Committee.

The risk and chance management reporting system is divided into two complementary fields of reporting, resulting in successful risk and chance management. Risks and chances are not only reported in annual reports and quarterly updates but also in monthly controlling reports. In addition, risk managers are obligated to report sudden major risks to the Board of Managers.\(^\text{150}\)

The risk and chance management process is monitored by using the normal internal controls (separation of functions, including vertical separation of functions). Furthermore, the risk and chance management system in the risk-based audit plan is tested and assessed by the group’s audit.

These tests are based preferably on the effectiveness of the monitoring system. Additionally, every year there is a group-wide review of the risk and chance management system by the auditors. This is to test whether the monitoring system performs its tasks.

Through regular risk and chance-workshops and/or discussions of risk management – with the respective responsible staff, the main risks are discussed for risk assessment and risk reporting.

The risk and chance management handbook of RAG is the detailed implementation of the risk management policy of the group. Information sessions, lectures and training courses for risk and chance management have been performed since the adoption of KontraG across the group since 1998.

As another part of the risk management system, the Board of Managers of RAG in 2007 decided to establish the Compliance Organization. Compliance covers the entire activities to protect the conduct of the company, in order to guarantee the

\(^{150}\text{RAG Corporation (2011)}\)
Board of Managers and employees meet the statutory provisions and prohibitions and comply with company-specific rules and regulations. The essential elements of compliance for RAG are a code of conduct and a compliance program that includes the responsibility of the Compliance Officers, in particular proactive communication\(^{151}\).

Risk management should be set up as a system because it can promote activities in different fields like quality, environment and economical successes in addition to safety\(^{152}\).

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure2_5.png}
\caption{	extbf{Integrated risk management system}
\footnotesize{(Adapted from H. Jacobi, 2009)}}
\end{figure}

Figure 1.4 shows how the risk management system should be adapted to the company's strategy. Especially in geological issues, it is said that “prognosis of the mining hazards should be an important component of the management system of mining companies both at the stage of planning and conducting of mining works”\(^{153}\).

As a part of strategic management, it is necessary to concern the impact of external factors on risk management. Thus, stakeholders can take external factors into account of threats and opportunities for the company\(^{154}\).

\begin{flushright}
\footnotesize\textsuperscript{151} Das Risikomanagementsystem der RAG Aktiengesellschaft - Kurzüberblick (2009)  \\
\footnotescript{152} H. Jacobi (2009), Lectures on \textit{Risikomanagement}, Wintersemester 2009/2010, RWTH Aachen  \\
\footnotescript{154} J. Kretschmann (2000), p.8
\end{flushright}
A national economy can be improved, politics can be changed, technology can be transferred, and therefore social aspects can be gradually developed. Among the factors mentioned, culture seems difficult to change especially in the short-term, and this factor has a major influence in establishing safety measures and risk management, such as the improvement of safety competence and safety culture, building concepts of risk and risk management, and treatment of risks etc. Many nations have their own beliefs about how to avoid risk, for example, the miners in Japan do not whistle while they are underground (otherwise a goddess will “bring” them away - by a blast in the furnace). In Vietnam, people avoid mentioning bad luck or unsafe things before they do something important. They also do not want women to be the first people they see in the early morning when they go to work, as that will bring them bad luck. Due to social pressure, especially in Asia, a lot of people think that a good occupation is a high income job, not necessarily one with lower risks. Hence, it can be said that in risk management system in Southeast Asia, socio-cultural factors are having very important impacts. This aspect will be mentioned in details as one of the requisites for the transference of the German risk management in coal mining to Southeast Asia.
### Work safety management
- **Incentive systems**
  - Safety work code award
  - Bonus system
  - Reward system
- **Collaboration partners**
  - Associations
  - Trade unions
  - Trade fairs
  - Schools, colleges, university
  - In-house events
- **Events**
  - Protect forum
  - Industry congress
  - BAUZ – newspaper for policy holders
- **Media**
  - Bulletins
  - Newsletters
  - Annual reports
  - Brochures
  - Videos
  - CD – ROMs
  - Safety packages
  - “Work Health Life” practical help
- **Personal contacts**
  - In a seminar
    - Practical manual
    - Company physician
  - In a company
    - TAB (Technical supervision and advice)
    - Safety engineer
    - Occupational physician
    - TAB (Technical supervision and advice)
  - TAB (Technical supervision and advice)

### Contacts and products
- **Target-groups**
  - Employers (SMEs)
  - Policy holders
  - Safety experts
  - Safety representatives
  - Company doctors
  - Works councils
  - Foremen and management
  - Employers (large companies)

### Table 2.1 Preventive action areas in risk management systems
Adapted from J. Kretschmann and H. Ehnes, 2011
In the Trade Association for raw materials and the chemical industry in Germany, a union of 35,000 companies with 1.3 million employees, a system for risk management is supported by preventive action areas within numerous of activities and target groups.\textsuperscript{155}

Table 2.1 illustrates preventive actions: the activities related to preventive measures in safety management, such as incentive systems, and the co-operation of associations and trade unions, and educational organizations, in many events like trade fairs and in-house events etc.

The media also has contributed to risk management system through bulletins, newsletters, annual reports, brochures, videos and CD-ROMS, etc. Safety engineers play significant role in allowing people in charge to join adequate safety programs. These activities can be applied to various people, such as employees in different levels throughout the company, policy holders, safety experts and representatives, company doctors, workers and managers, etc.

Various target groups are supported by the collection of documents which are widely used in companies such as: brochure of the employers’ model, risk assessment handbook, conveyor belt safety guidelines, aided briefing, description of safety models, documents for seminars and trainings, bonus system, etc.

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<tr>
<td>Accident hazard point</td>
<td>Seminars and trainings</td>
<td>BAUZ – Newspaper for policy holders</td>
</tr>
<tr>
<td>Fit for job and life</td>
<td>Bonus system</td>
<td>Work – Health – Life</td>
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<td>Work Safety Health Award</td>
<td>Conveyor Belt Safety</td>
<td>Systematic Safety</td>
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<tr>
<td>Manual</td>
<td>Aided briefing</td>
<td>Campaign “Fight the Risks”</td>
</tr>
</tbody>
</table>

Table 2.2 Elements of adequate measures for improvement of risk management system
(Adapted from J. Kretschmann and H. Ehnes, 2011)

\textsuperscript{155} J. Kretschmann, H. Ehnes (2011)
In the Trade Association for raw materials and the chemical industry in Germany, a union of 35,000 companies with 1.3 million employees, a system for risk management is supported by preventive action areas within numerous of activities and target groups.¹⁵⁶

Mining companies also contribute to the reduction of damages from technical risks through the concept of “Safety First”. For example, the Environment, Health and Safety (EHS) vision of Sandvik Mining and Construction is zero harm when working with their mining equipment.

A specific “Product Safety Process” has been integrated, where all safety activities like identification of all life cycle hazards, risk management and safety verification, and validation are planned, performed and documented (Figure 2.7)¹⁵⁷.

![Diagram of Product Safety Process](image)

Figure 2.7  **Product safety is an integrated process**  
(Adapted from E. Lammer, 2011)

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¹⁵⁶ J. Kretschmann, H. Ehnes (2011)  
Choosing adequate equipment and reasonable investment is therefore a part of risk management. However, there are companies which have low financial capacity and disadvantageous geological conditions, or no other alternatives but the intensive use of labors due to social issues (to reduce unemployment rate for instance). It is thus difficult to invest in advanced and expensive machines and equipments.

As risk management is a system and an integral management function, the author suggests some features of risk management, which are: (1) under impacts of internal and external factors of the system itself, (2) for better results, the management system should be a part of the cycle improvement procedure: Plan – Do – Check – Act\textsuperscript{158}, (3) implementation from the very beginning of any business and continued throughout the whole business procedure; and (4) lean production helps reduce the negative impact of risks.

Feature (4) is inspired by RAG Lean Processing Program, which they offered in order to improve management, teamwork and performance, and to develop productivity. From 2002 the Lean Processing Program has been developed for improving productivity in RAG\textsuperscript{159}. The essence of lean processing is getting the right things to the right place at the right time in the right quantity, to achieve a perfect work flow, while minimizing waste and being flexible. It helps to eliminate inefficient partial works and, thus restrict incidents which can occur in these works.

2.2.2 The risk management system in German coal mines: theory and practices

The German Law of Control and Transparency (KontraG, stipulated on 1\textsuperscript{st} May, 1998) was fundamental for the handbook of risk and chance management, which was proposed by the RAG Aktiengesellschaft\textsuperscript{160}. The main documents of the handbook include:

- Description of the early warning system;
- Definition of fields of risks;
- Principles of risk and chance identification, analysis, assessment, treatment, communication;

\textsuperscript{158} J. Kretschmann, N. Nguyen (2011a)
\textsuperscript{159} RAG Lean Processing Program (2008), Grundlagen aktualisiert
\textsuperscript{160} RAG (2009)
- Principles of identification and response to changes;
- Definition evolving responsibilities and powers;
- Arrangements for reporting and tracking risk and chance; and
- Internal controls of the risk and chance management system.

According to the KontraG and their handbook, adequate commitment among the miners, along with the combined efforts of companies, unions and authorities help to lower the accident rate in the German coal mining industry. For example, in 2008 there was only one fatality in the German Hard Coal Mining Company.\(^{161}\)

Not only is the KontraG is a fundament to improve occupational safety and health in the company but also other codes such as the German Social Law Code VII which stipulates responsibilities of employers: (1) to do everything possible to prevent occupational accidents, occupational diseases and occupational health hazards; (2) to do everything possible to restore the health of the employees or provide financial compensation.\(^{162}\)

The combination of data from the German Social Accident Insurance company (Deutsche Gesetzliche Unfallversicherung – DGUV)\(^{163}\), RAG, and the German Coal Association (Gesamtverband Steinkohle e.V)\(^{164}\) shows RAG’s prominent achievement through taking adequate measures in dealing with accidents: since 2006, the accident rate (accidents per 1 million hours worked) in the coal industry (13.8) is

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\(^{161}\) W. Hermülheim, R. Schumachers, C. Dauber (2009)


\(^{163}\) The German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung) is the umbrella association of the accident insurance institutions for the industrial and public sectors (the Union Trades – Berufsgenossenschaft – and the public – sector accident insurers respectively). It assumes responsibility for the common interests of its member institutions and promotes their functions in the interests of both member companies and insured individuals. The DGUV represents the statutory accident insurance institutions in their dealings with policymakers, regional, national, European and international institutions, and employers’ and employees’ representative bodies.

\(^{164}\) The German Coal Association (Gesamtverband Steinkohle e.V - GVST) was established by 11 founders as the General Association of the German Coal mining industry. The Association has a statutory function; with the common concerns from its members being economic and social policy. GVST perceives, promotes and represents its members as an ordinary employer association and a tariff party. The activities of GVST cover the area beyond the national level of the European Union and the participation in other international organizations. GVST also participates in public-policy and decision-making in Germany.
lower than Germany’s entire commercial and industrial sector (17.9)\textsuperscript{165}. As of May 2013, the accident rate reached 3.7 per 1 million working hours\textsuperscript{166}.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.8.png}
\caption{Falling accident rates in the German coal industry (Adapted from German Coal Association, annual report 2010)}
\end{figure}

The main reason for this tremendous achievement was due to the commitment of stakeholders and the essential idea which the author called “First Chance Prevention”\textsuperscript{167}, which is shown in a series of activities in occupational health and safety management to be a core element in risk management. Information on all the potential risks are updated and revised regularly. Frequent short meetings are conducted before work begins and safety regulations and standards are reviewed. According to W. Hermülheim et al., a series of priority activities was listed to help RAG improve safety. The activities are divided into three groups based on the criteria of application periods: (1) The most important precautionary measures; (2) Complementary precautionary and initial preventive measures; and (3) Further preventive measures\textsuperscript{168}.

\textsuperscript{165} German Coal Association (2010), Coal Annual report: Coal 2010 – Our natural resource, our security, p. 23
\textsuperscript{166} M. Junker (2013)
\textsuperscript{167} J. Kretschmann, N. Nguyen (2011a)
\textsuperscript{168} W. Hermülheim, R. Schumachers, C. Dauber (2009)
Figure 2.9  Decreasing accident rates in the German Hard Coal mining industry  
(Adapted from W. Hermülheim et al., 2009)

Recordable accidents\(^{169}\) per million working hours were separated from quantity of output. By this calculation, the German Hard Coal mining industry does care about productivity. In order to improve safety the German Hard Coal mining industry has introduced the concept of “Null-Unfall” (Zero-accident), with the idea of decreasing the accident rate, with support from technology, organizational and labor forces\(^{170}\).

Regarding mine rescue, mine ventilation, and fire and explosion prevention, there exists a collaboration between a central mine rescue station and the mine ventilation department of RAG. Their tasks and activities cover underground rescue, self-rescue, fire and explosion prevention, mine ventilation, and mine gas treatment. The total workforce in these fields is about 50 engineers, technicians, and maintenance personnel.

\(^{169}\) Official website of German Social Accident Insurance: http://www.dguv.de/content/facts_figures/begriffe/index.jsp: A reportable accident is a work-related accident or commuting accident which is either fatal or leads to an incapacity to work for more than three days (accessible in September 2012)

\(^{170}\) D. Mantwill (2011), Der Mensch ist der Schlüssel zum Erfolg: The accident-free mine: illusion or reality?, Presentation at the ISSA Mining Symposium „Safety and Health in Mining“ within the World Mining Congress, Istanbul, Turkey 2011
Figure 2.10  Decreasing number of accidents per 1 million working hours in the German Hard Coal mining industry
(Adapted from M. Junker, 2013)

RAG organized duties for their mine rescue station and ventilation department including:

- Supervision and training of mine rescue brigades;
- Supervision, training and workshop services in air protection and chemical protection;
- Support and counsel to the command centre staff in the case of major emergencies;
- Assessment of preventive and fire fighting measures against spontaneous combustion of coal (monitoring and early detection, goaf and roadway sealing, Nitrogen-inertization);
- Protection from underground fire and explosion;
- Planning layout of main fans, direct heat exchangers, and coolers;
- Planning dust exhaust systems and ventilation plants for road heading;
- Control gas and climate in tunnels, road heads and other mine workings including gas drainage systems;
- Modelling and calculating ventilation networks;
- Detecting and monitoring mine gas; and
- Monitoring control-room systems171.

171 W. Hermülheim, R. Schumachers, C. Dauber (2009)
Generally, in the field of occupational safety and health, standards and norms have been developed for technical equipment in addition to technical and safety regulations and standards, which are regularly updated\textsuperscript{172} in accordance with the Joint German Occupational Safety and Health strategy\textsuperscript{173}.

Safety work requires the combination of the hierarchy from the top to the bottom (top-down) and vice versa (bottom-up). For example, it was possible to reduce the accident rate by more than 82\% since 1995 (Figure 2.9) for all recordable accidents (underground and on the surface). The number of fatal accidents in underground mines dropped from a death toll of 13 in 1994 to zero in 2006\textsuperscript{174}. With precisely 10.1 accidents per million working hours (December 2008), RAG was below the industrial average\textsuperscript{175,176}. This is such an outstanding result, as in many countries, mining and construction industry usually rank highest in terms of occupational accidents\textsuperscript{177,178,179,180}. In 2007, RAG planned to bring the accident rate down to fewer than 5 cases per one million working hours in 2012\textsuperscript{181} and they certain reached their target with 4.3\textsuperscript{182}. As of June 2013, this rate was 3.7\textsuperscript{183}.

It was assessed that the successes of the RAG are the result of a long-term strategy based on the company’s health and safety management system. As a result of the

\textsuperscript{172} Joint German Occupational Safety and Health Strategy (2007), \textit{Detailed concept and occupational safety and health objectives 2008 – 2012} p.10

\textsuperscript{173} Official website of the Joint German Occupational Safety and Health Strategy (Gemeinsame Deutsche Arbeitsschutzstrategie) http://www.gda-portal.de/en/Objectives/Objectives.html: \textit{Objectives and Strategy}

The Joint German Occupational Safety and Health Strategy is supported by the federal, states and accident insurance. The aim of corporation is to improve the safety and health of employees through a systematic prevention and promotion of safety perception. The objective of the Joint German Occupational Safety and Health Strategy is to maintain, improve and promote the safety and health of workers by means of the efficient and systematic implementation of occupational safety and health – supplemented by workplace health promotion measures.


\textsuperscript{175} W. Hermülheim, R. Schumachers, C. Dauber (2009)

\textsuperscript{176} German Coal Association, \textit{Coal annual report 2010}

\textsuperscript{177} Ministry of Labor, Invalid and Social Affairs, \textit{Annual reports on national accidents (from 2006 – 2010)}, Synthesized data (Vietnamese)

\textsuperscript{178} http://sourcewatch.org/index.php?title=Coal_mining_disasters: \textit{Coal mining disaster} (website validity in November 2011)


\textsuperscript{181} D. Mantwill (2007)

\textsuperscript{182} M. Junker (2013)

\textsuperscript{183} M. Junker (2013)
continuously improved technology, it was found that only about 20% of all accidents could now be attributed to technical causes. The greatest proportion of all accidents, accounting for 80% of the total amount, was attributed to malpractice caused by inadequate safety awareness of managers and workers\textsuperscript{184}.

The Vietnamese coal mining industry realized the same imbalance in causes of accidents\textsuperscript{185}. Hence, it can be said that both the German and Vietnamese coal mining industries aim to improve safety awareness within the workforce. The Vietnamese coal mining industry can also benefit from the training concepts and programs of Germany, as German authorities realize that “the hitherto predominantly technically orientated maintenance of industrial health and safety standards could only be optimized further through a fundamental new strategy in safety work”\textsuperscript{186}, in a more proactive and preventive way\textsuperscript{187} whilst the representative of Vietnam stated that it needed to conduct concrete programs in occupational safety and health in Vietnam for the upcoming decades when they will be continuing development in underground excavation\textsuperscript{188}.

The German accident prevention and insurance association for the raw materials and chemical industry BG RCI (Berufsgenossenschaft Rohstoffe und Chemische Industrie)\textsuperscript{189} has developed a special employer’s model for operations with up to 50 employees. It is long-term tried and tested approach for responsible stakeholders, involving occupational safety and health management\textsuperscript{190}.

Elements of the employer’s model are suggested as follows: (1) Regular information and motivational seminars for employees and further training; (2) Safety-related advice by safety engineers if required; and (3) Occupational medical care and

\textsuperscript{184} W. Hermülheim, R. Schumachers, C. Dauber (2009)
\textsuperscript{185} Q.H. Phung et al. (2010)
\textsuperscript{186} W. Hermülheim, R. Schumachers, C. Dauber (2009)
\textsuperscript{187} J. Kretschmann, N. Nguyen (2011a)
\textsuperscript{188} V.K Doan (2010), Opening speech of Halong International Conference: Advanced mining for sustainable development, Halong, Vietnam, September 2010
\textsuperscript{189} Official website of the German accident prevention and insurance association for the raw materials and chemical industry, http://www.bgrci.de/wir-ueber-uns/unsere-aufgaben/: The German accident prevention and insurance association for the raw materials and chemical industry BG RCI is a commercial trade association, mandating to work accidents and occupational diseases and work-related health hazards (prevention). The organization supports companies in all aspects of occupational safety, educates assurers, explores causes of accidents and examines technical tools.
\textsuperscript{190} J. Kretschmann, H. Ehnes, (2011)
medical check-ups by physicians if required\textsuperscript{191}. \textit{Therefore, the motivational seminars for employees in coal mining for the improvement of their safety awareness and self-implementation at work are important for the transference of the risk management system from Germany.}

The effect of the employer’s model was also considerable, since the introduction of the model the accident risk decreased by 40\%\textsuperscript{192}. According to the BG RCI’s statistics on the causes of accidents, technical deficiencies (including technical causes) accounted for 10\%. The remaining 90\% came from organizational and behavioral deficiencies, which included no training, poor planning and preparation of work, poor communication, poor co-ordination, fuzzy responsibilities and weak inspections\textsuperscript{193}.

BG RCI created the Work – Safety – Health Award\textsuperscript{194} to collect examples of good practice in mines of any size in 1997 with an annual prize fund of 100,000 Euros. This way, literally thousands of innovations to improve safety and health have been collected and distributed, while the awareness for these matters have been raised significantly amongst miners.

Another cornerstone in incentives is economic stimulus. Investment in safe technology can improve standards tremendously. This seems to be difficult for medium and small business in regard to their financial situation, thus since 2005, BG RCI has established a stimulus system and paid out more than 15 million Euros to assist mainly small and medium sized mines to invest in safe technology\textsuperscript{195}.

Implementing a successful risk management system depends both on the motivation and ability of different stakeholders\textsuperscript{196}.

\begin{itemize}
\item \textsuperscript{191} J. Kretschmann, H. Ehnes, (2011)
\item \textsuperscript{192} J. Kretschmann, H. Ehnes, (2011)
\item \textsuperscript{193} M. Stenzel (2010)
\item \textsuperscript{194} Official website of The German accident prevention and insurance association for the raw materials and chemical industry BG RCI (Berufsgenossenschaft Rohstoffe und Chemische Industrie) http://www.bgrci.de/presse-median/pressemeldungen/pms/bgrci-vergibt-fuerderpreis-arbeit-sicherheit-gesundheit-2011/
\item \textsuperscript{195} J. Kretschmann, H. Ehnes (2011)
\item \textsuperscript{196} J. Kretschmann, N. Nguyen (2011b)
\end{itemize}
In Figure 2.11, case 1 seems to be ideal for risk management implementation, with support from knowledge and technology and sponsorship from financial incentives. Excellent performance can be expected due to the willingness and ability of staff. Meanwhile, case 3 can be considered the typical model of companies with high skills and knowledge but less willingness for improvement. Technology or know-how transfer to companies without motivation for improvements is ineffective and a waste of time and money. Case 2 shows companies with highly motivated employees who do not possess the required technologies, skills or knowledge. A lack of knowledge and skills obviously makes it difficult to achieve improvements in implementing advanced technology and in risk management.

The Vietnamese coal mining industry as well as other Southeast Asian mining industries will be able to obtain the effective risk management system of the German coal mining industry. What have been done so far in the field of risk management in Vietnamese hard coal mines will be presented in the next part (as a case study) to show the major challenges in forthcoming years for the sustainable development of the coal mining industry.

Figure 2.11  Model of the relationship between willingness and ability in risk management
(Adapted from J. Kretschmann and N. Nguyen, 2011b)
Case study – The Vietnamese coal mining industry: state-of-the-art in risk management

3.1 Introduction to the Vietnamese coal mining industry

3.1.1 General information

After stepping back from the financial brink in the last years of the 20th century, Vietnam has maintained a long period of rapid economic growth of 7.5% per year between 2004 and 2007197. Although the government’s target of growth rate by Gross Domestic Product (GDP) was 6.5%198, after the recession in 2009 it still reached 6.9% by the end of the year199. Industry expanded by 6.5% in the first half of 2010, with double-digit growth in production of electricity, gas and water, and a rebound in manufacturing to nearly 8% growth (from just 2% a year earlier) as world trade in manufactured goods recovered200. Preliminary data show that the GDP rose by 5.4% year on year in January – March 2011, slowing from 7.3% in the fourth quarter of 2010201. The expansion of industry in fields such as electricity202, fertilizer203, and cement204 will lead to the huge demand of coal in this emerging country in upcoming decades. The domestic coal industry, therefore, is an important supplier for these industries.

Nowadays, the Vietnamese coal mining industry is based mainly on the contribution of the Vietnam National Coal, Minerals Industries Holding Corporation Ltd. (Vinacomin), a consortium of 64 members in various fields such as the coal industry, power industry, mining chemical industry, construction materials, investment construction, real estate business, machinery and other services (geological

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202 Decision 110/2007/QD – TTg (18/7/2007), Development strategy of electronic industry, stated that the electricity production from coal power should reach the capacity of 4 400 MW in 2010. From 2011 to 2020, total demand is about 4 500 – 5 500 MW (basic scenario) or 8 000 – 10 000 MW (high scenario)
203 Decision 6868/2010/QD – TTg (27/12/2010) Master plan of production and distribution development of fertilizer industry, coal demand of the industry in term of 2011 – 2015 is about 1 970.5 thousand tons per year, during 2016 – 2025 is about 2 015.5 thousand tons per year
204 Mining Industry Investment Consulting Company Limited (2010), Master plan for the development of the Vietnamese coal mining industry to 2020, outlook to 2030, Chapter 6: Coal demand forecast (Vietnamese), coal demand of the industry from 2010 to 2030 will increase from about 6 million tons in 2010 to 14 million tons in 2030
exploration, survey and mapping; seaport, marine, transport; trading, tourism; scientific research and technological study; training; and healthcare). Vinacomin is the dominant coal producer with an output of over 95% of the country’s total coal production. This consortium owned nearly US$ 470 million capital and US$ 974 million of shares, created US$ 3.26 billion of revenue and ranked 9th of the largest company in Vietnam in 2012.

Vinacomin is also one of the most important employers in Vietnam. At the end of September 2011, there were 136,133 employees in the Corporation, of which 83,012 workers were employed in mining excavation companies.

The structure of Vinacomin contains coal production units and other units which support coal excavation: mining construction, measuring and quality checking, mining safety, import – export and international corporations, logistics, and geo-mining etc. Additionally, they have two vocational training colleges and one training center for human resources.

![Figure 3.1 Geographic location of Quang Ninh Province – Vietnam](image)

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205 Official website of Vinacomin: [http://www.vinacomin.vn](http://www.vinacomin.vn) (Vietnamese)
206 X.H. Tran (2010a), *Perspective and challenges to sustainable development of Vietnam coal industry*, Presentation at the International mining conference Advanced mining for sustainable development, Ha Long, Quang Ninh, September 2010
About 98% of the coal deposits which are being excavated are located in the North East coal basin (Quang Ninh Province).\textsuperscript{210} Resources are located within an area of 1400 km\textsuperscript{2} with a width of between 10 to 30 km, stretching from the arc Dong Trieu to the vicinity of Halong Bay and Bai Tu Long Bay.\textsuperscript{211}, which the United Nations Educational, Scientific and Cultural Organization (UNESCO) recognized as a natural world heritage site.\textsuperscript{212}

As a consequence of the “Đổi mới” (Renovation) policy of the Vietnamese government in the second half of the 1980s,\textsuperscript{213} domestic production was expanded, bringing growth to the coal industry. Moreover, due to the lifting of the embargo by the U.S government, the Vietnamese coal mining industry could gradually broaden its export markets, which was previously limited to mainly Eastern Europe countries. The international customers of Vinacomin today are from Japan, China, Taiwan, South Korea, India, the Philippines, Thailand, Malaysia, Indonesia, Laos, North-East European countries, Bulgaria and Brazil.\textsuperscript{214} Domestic consumers come from 4 major industries: electronic, cement, fertilizers and pulping, and other minor industries.\textsuperscript{215}

\textsuperscript{209} D. D. Nguyen et al. (2004), Land use changes and GIS – database development for strategic environmental assessment in Halong Bay; Quangninh Province, Vietnam, Institute of Geography, National Center of Science and Technology of Vietnam.

\textsuperscript{210} Mining Industry Investment Consulting Company Limited (2010), Master plan for the development of the Vietnamese coal mining industry to 2020, outlook to 2030, Chapter 5: State-of-the-art in coal production (Vietnamese).

\textsuperscript{211} Mining Industry Investment Consulting Company Limited (2010), Master plan for the development of the Vietnamese coal mining industry to 2020, outlook to 2030, Chapter 7: Geological features of coal deposits (Vietnamese).

\textsuperscript{212} Official website of the United Nations Educational Scientific and Cultural Organization (UNESCO) http://whc.unesco.org/en/list/672

\textsuperscript{213} German Development Cooperation (GTZ), (undefined year-of-publication): Sustainable Economic Development: Vietnamese economic reforms, socialist versus social orientation – a policy debate. Online at http://www2.gtz.de/wbf/4tDx9kw63gma/VN_economic_reforms_socialistvs_social_orientation.pdf (link available in August 2012): After failing to reach economic output targets under the centrally-planned economy in the 1980s, the country faced serious financial, economic and social problems. In response to this acute failure of the state, in 1986 (at the 6th Party Congress) the Vietnamese political leadership formally abandoned the centrally-planned economy and began introducing market-oriented policies. These so-called Doi Moi (Renovation) reforms initiated a development process, during which Vietnam has achieved high economic growth performance, among other success. Four main stages of development can be distinguished: (1) 1986 Land reform, (2) 1990/1991 Recognition of private ownership, (3) 1995/1996 Liberalization of foreign trade, and (4) 1999 Right of business freedom.

\textsuperscript{214} X.H. Tran (2010b), Coal export and the future in Vietnam, International Symposium on Clean Coal Technology, Japan 2010

\textsuperscript{215} Mining Industry Investment Consulting Company Limited (2010), Master plan for the development of the Vietnamese coal mining industry to 2020, outlook to 2030, Chapter 22: Balance of the supply and the demand of the coal industry (Vietnamese).
Major indices of Vinacomin are aggregated in table 3.1, which shows the results of its production and distribution since 2000 after the financial crisis in Southeast Asia\(^{216}\). The quantity of raw coal excavation and salable coal increased approximately by a factor of four in ten years (2000 – 2010) with the expansion of underground excavation and elimination of open-cast mines\(^{217}\). Proven coal reserves are 235,742,000 tons from the resource of 9,903,604,000 tons of coal in the North East coal basin\(^{218}\).

### 3.1.2 Features of collieries

As of 2010, Vinacomin owned more than 30 collieries, 9 of them maintain capacities of more than 1 million tons of coal per year: Mao Khe (1.6 million tons), Nam Mau (1.5 million tons), Vang Danh (3.1 million tons), Ha Lam (1.77 million tons), Quang Hanh (colliery Nga Hai 1.05 million tons), Khe Cham (1.1 million tons), Duong Huy (colliery Khe Tam 2.0 million tons), Thong Nhat (colliery Lo Tri 1.59 million tons) and Mong Duong (1.5 million tons)\(^{219}\).

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“Since 1997, the financial crisis made the GDP grow slowly, domestic saving had not increased, the current account deficit remained high although the value of import had fallen sharply since the third quarter of 1997, foreign direct investment was falling, the performance of the state-owned enterprises and commercial banks had been much lower than that in previous years, and unemployment had been rising fast. At that time Vietnam was still dependent on exports of raw commodities and therefore is vulnerable to adverse commodity price development” (p.97).

“In industries exploiting natural resources, the jobless workers reached 15 percent of total unemployment in 1998” (p. 112).

“The coal industry was suffering from the same unemployment rate: many coal mines had been forced to stop running or to reduce their production because of the crisis. As a consequence, thousands of workers had been obliged to cut short their working hours, and 15 000 “seasonal” workers were at risk of having to leave the mines. The monthly average income of miners had fallen from 1.4 million dong in 1997 to 700 000 dong in September 1998” (p. 113).

\(^{217}\) Mining Industry Investment Consulting Company Limited (2010), *Chapter 11: Master plan of coal excavation* (approved) (Vietnamese)

\(^{218}\) Mining Industry Investment Consulting Company Limited (2010), *Chapter 8: Coal resources and reserves* (Vietnamese)

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<td>1. Quantity of sale (10^6 tons)</td>
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<td>13.0</td>
<td>14.8</td>
<td>18.8</td>
<td>24.9</td>
<td>30.2</td>
<td>37.6</td>
<td>41.6</td>
<td>35.4</td>
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<td>14.7</td>
<td>21.6</td>
<td>24.1</td>
<td>17.2</td>
<td>24.3</td>
<td>18.7</td>
<td>16.9</td>
</tr>
<tr>
<td>Domestic</td>
<td>8.4</td>
<td>8.8</td>
<td>9.3</td>
<td>12.3</td>
<td>14.4</td>
<td>15.5</td>
<td>16.0</td>
<td>17.5</td>
<td>18.2</td>
<td>20.2</td>
<td>24.4</td>
<td>27.8</td>
</tr>
<tr>
<td>2. Salable coal (10^6 tons)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>31.3</td>
<td>37.0</td>
<td>42.2</td>
<td>38.6</td>
<td>43.0</td>
<td>43.5</td>
<td>45.0</td>
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<tr>
<td>3. Raw coal (10^6 tons)</td>
<td>12.2</td>
<td>14.6</td>
<td>17.1</td>
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<td>26.2</td>
<td>34.1</td>
<td>40.7</td>
<td>45.5</td>
<td>44.7</td>
<td>44.9</td>
<td>46.9</td>
<td>48.3</td>
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<tr>
<td>Open casts</td>
<td>7.9</td>
<td>9.5</td>
<td>11.0</td>
<td>13.0</td>
<td>17.4</td>
<td>20.7</td>
<td>24.5</td>
<td>26.8</td>
<td>25.3</td>
<td>25.8</td>
<td>26.5</td>
<td>26.2</td>
</tr>
<tr>
<td>Ratio (%)</td>
<td>64.75</td>
<td>65.07</td>
<td>64.33</td>
<td>65.00</td>
<td>63.04</td>
<td>60.70</td>
<td>60.20</td>
<td>58.90</td>
<td>56.60</td>
<td>56.21</td>
<td>56.52</td>
<td>54.10</td>
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<tr>
<td>Underground</td>
<td>4.3</td>
<td>5.0</td>
<td>6.1</td>
<td>7.0</td>
<td>9.8</td>
<td>12.5</td>
<td>14.7</td>
<td>16.3</td>
<td>17.6</td>
<td>18.2</td>
<td>19.9</td>
<td>21.5</td>
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<tr>
<td>Ratio (%)</td>
<td>35.25</td>
<td>34.93</td>
<td>35.67</td>
<td>35.0</td>
<td>36.96</td>
<td>36.66</td>
<td>36.12</td>
<td>35.82</td>
<td>39.37</td>
<td>39.65</td>
<td>42.47</td>
<td>44.44</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.9</td>
<td>1.5</td>
<td>2.4</td>
<td>1.8</td>
<td>1.9</td>
<td>0.50</td>
<td>0.71</td>
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<tr>
<td>4. Overburden removal (10^6 m³)</td>
<td>33.9</td>
<td>47.4</td>
<td>63.9</td>
<td>87.2</td>
<td>122.7</td>
<td>165.0</td>
<td>193.0</td>
<td>211.0</td>
<td>216.5</td>
<td>208.7</td>
<td>228.8</td>
<td>273.8</td>
</tr>
<tr>
<td>Stripping ratio (m³/t)</td>
<td>4.56</td>
<td>4.90</td>
<td>5.68</td>
<td>6.7</td>
<td>7.1</td>
<td>7.5</td>
<td>7.8</td>
<td>7.9</td>
<td>8.5</td>
<td>8.0</td>
<td>8.5</td>
<td>10.5</td>
</tr>
<tr>
<td>5. Tunnel volume (10^7 m)</td>
<td>77.3</td>
<td>94.5</td>
<td>127.7</td>
<td>136.5</td>
<td>175.9</td>
<td>288</td>
<td>222.6</td>
<td>274.8</td>
<td>279.6</td>
<td>318.9</td>
<td>348.8</td>
<td>382.5</td>
</tr>
<tr>
<td>Drivage per 10^7 tons of coal</td>
<td>15.9</td>
<td>16.8</td>
<td>17.9</td>
<td>15.9</td>
<td>15.9</td>
<td>15.7</td>
<td>14.8</td>
<td>15.9</td>
<td>17.8</td>
<td>17.1</td>
<td>17.1</td>
<td>17.3</td>
</tr>
<tr>
<td>6. Revenue from coal (10^9 bil.VND)</td>
<td>3.1</td>
<td>3.9</td>
<td>4.8</td>
<td>6.3</td>
<td>9.8</td>
<td>15.3</td>
<td>18.4</td>
<td>22.9</td>
<td>34.1</td>
<td>36.4</td>
<td>50.5</td>
<td>65.3</td>
</tr>
<tr>
<td>Domestic (10^9 bil.VND)</td>
<td>1.9</td>
<td>2.3</td>
<td>2.6</td>
<td>3.7</td>
<td>9.8</td>
<td>15.3</td>
<td>18.4</td>
<td>22.9</td>
<td>12.8</td>
<td>13.8</td>
<td>21.7</td>
<td>32.8</td>
</tr>
<tr>
<td>Exports (mil$US)</td>
<td>87</td>
<td>109.8</td>
<td>140.2</td>
<td>165.1</td>
<td>322.2</td>
<td>595.9</td>
<td>750</td>
<td>890</td>
<td>1439</td>
<td>1279</td>
<td>1503</td>
<td>1544</td>
</tr>
</tbody>
</table>

Table 3.1 Major index of the Vietnam National Coal, Minerals Industries Holding Corporation Limited

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220 Vietnam National Coal, Minerals Industries Holding Corporation Limited, Vietnamese, Synchronized data from annual reports
3.1.3 Technology and infrastructure

In most collieries, the basic infrastructure includes inclined shafts and adits in sublevels, using belt-conveyors for coal transport in the main shafts. In other mines, which have suitable geological conditions, coal can be extracted by adits cut mining and using trains for internal coal transport.

However, due to unsynchronized mechanization in underground mines, in small scale collieries the average rate of productivity is between 3 to 6 tons per man-shift (of workers at the coal faces), the advance rate was at an average of 18 – 25m per month and the loss rate of coal in excavation was quite high, from 55 to 65%.

Until 2010, Vinacomin installed equipment at mechanized faces in 3 companies: Khe Cham (2005), Vang Danh (2006) and Nam Mau (2010). In these large and mechanized collieries, particular faces could achieve a capacity of up to 2,500 tons of coal per day, and productivity reached 7.5 tons per man-shift. However, according to the assessment of experts from Deutsche Bergbau Technik – DBT, geological mining conditions in underground coal mines in Vietnam are complicated, and these can be classified as “difficult to mechanize”.

Thus, technology level in Vinacomin is assessed in average standards. Before 2000, coal excavation in underground mines was done entirely by hand except for drilling and blasting, using timber props. Single hydraulic props have been used...

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222 Q.L Dau (2004), *Some results in technology reform in underground mines in Uong Bi Coal Company*, Special publication of technology and science for 10 – year anniversary of Vietnam Coal Corporation, p. 43 – 45 (Vietnamese)
223 Q.H. Phung et al. (2010)
224 http://www.steinkohle-portal.de/content.php?id=158: (German) A global success: Mining technology Made in Germany: German Mining Technology Ltd (DBT GmbH) was wholly owned by RAG Coal International as a subsidiary of RAG Aktiengesellschaft. The company was then sold to Bucyrus International in May 2007 and as of 2011 belongs to Caterpillar Corporation Inc. The DBT group consisted of 15 companies in eight countries with approximately 25 services around manufacturing and mining. Major markets were in North and South America, Africa, Australia and China. Worldwide, the DBT group employed 3 200 employees, including 60 percent outside of Germany.
since 1997 and are considered one of the most successful developments in the Vietnamese coal mining industry, increasing output, quality of coal (reduce ratio of milled wood in coal) and improving working conditions at faces, etc \(^{227}\).

Nowadays, there are about 60 coal faces which use hydraulic props. Together with the drilling and blasting mining method, using hydraulic props helps to increase productivity and maintains safety in collieries \(^{228}\). Faces that are propped by timber supports represent 4% of all faces \(^{229}\).

According to A.T. Nguyen (2011), some of the main reasons which deeply impact the effects of mechanization in collieries in Quang Ninh province are:

- Complicated geological conditions;
- Lack of skill of underground miners in applying new technology;
- Mechanized equipment and spare parts are mostly imported. Therefore, it takes time for repair and replacement if incidents happen;
- Ineffective maintenance at work;
- Inadequate equipment, leading to low productivity and high investment; and
- Low motivation and less effective financial incentives to enforce mechanization at subsidiary level and production level \(^{230}\).

Ventilators used underground are made in China and Russia. The major advantages of these ventilators are their low electric cost and high capacity. By the end of 2010, there were 74 main stations of ventilators and 236 multi-level local ventilators with high capacity for long wall faces, which partly reduce gas accumulation and explosions as well as reducing electricity costs \(^{231}\).

\(^{228}\) T.T. Pham (2011)
\(^{230}\) A.T. Nguyen (2011)
**Mining systems with blast - hole excavation method**

<table>
<thead>
<tr>
<th>Index</th>
<th>Unit</th>
<th>Long wall retreating on strike - wooden props</th>
<th>Long wall retreating on strike – single hydraulic props</th>
<th>Mechanized faces combined with 2 ANSH – shields</th>
<th>Slicing system with automatic hydraulic prop-shield</th>
<th>Long wall retreating on strike – automatic hydraulic bracket</th>
<th>Long wall retreating on strike - automatic hydraulic bracket</th>
<th>Sublevel stoping</th>
<th>Mining system with automatic hydraulic prop-shield</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
<td>(10)</td>
</tr>
<tr>
<td>1</td>
<td>Thickness of coal seams</td>
<td>M</td>
<td>≤2,5</td>
<td>≤2,5</td>
<td>1,1 ÷ 2,2</td>
<td>≥5</td>
<td>2,2÷10</td>
<td>3,2÷10</td>
<td>≤5</td>
</tr>
<tr>
<td>2</td>
<td>Average dip angle of coal seams</td>
<td>Degree</td>
<td>&lt; 40°</td>
<td>&lt; 35°</td>
<td>&gt; 45°</td>
<td>≥35°</td>
<td>≤35°</td>
<td>35÷45°</td>
<td>≥45°</td>
</tr>
<tr>
<td>3</td>
<td>Coal density</td>
<td>T/m³</td>
<td>1,2 ÷ 1,6</td>
<td>1,2 ÷ 1,6</td>
<td>1,2 ÷ 1,6</td>
<td>1,2÷1,6</td>
<td>1,2÷1,6</td>
<td>1,2÷1,6</td>
<td>1,2÷1,6</td>
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<tr>
<td>4</td>
<td>Deduction height</td>
<td>M</td>
<td>2,2</td>
<td>2,2</td>
<td>1,1 ÷ 2,2</td>
<td>2,2</td>
<td>2,2</td>
<td>2,2</td>
<td>2÷3,5</td>
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<tr>
<td>5</td>
<td>Average length of face</td>
<td>M</td>
<td>80</td>
<td>120</td>
<td>60</td>
<td>7÷9</td>
<td>100÷120</td>
<td>80÷100</td>
<td>35</td>
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<td>6</td>
<td>Cycle advance</td>
<td>m/period</td>
<td>1,0</td>
<td>1,2</td>
<td>0,9</td>
<td>0,8÷1,6</td>
<td>0,8÷1,6</td>
<td>0,8÷1,6</td>
<td>2</td>
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<tr>
<td>7</td>
<td>Cycle output</td>
<td>Tons</td>
<td>230÷260</td>
<td>450÷500</td>
<td>700÷800</td>
<td>300÷450</td>
<td>200÷1300</td>
<td>250÷1000</td>
<td>200÷295</td>
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<td>8</td>
<td>Yearly output of face</td>
<td>10³ton</td>
<td>50÷70</td>
<td>100÷120</td>
<td>180÷200</td>
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<td>150÷250</td>
<td>100÷250</td>
<td>50÷80</td>
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<td>9</td>
<td>Manpower for a cycle</td>
<td>People</td>
<td>80÷90</td>
<td>70÷80</td>
<td>38÷42</td>
<td>22÷24</td>
<td>105÷140</td>
<td>93÷124</td>
<td>51÷60</td>
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<td>10</td>
<td>Productivity of 1 worker at face</td>
<td>T/man-shift</td>
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<tr>
<td></td>
<td>Roof control</td>
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<td>Timber prop per 1000t coal extracted</td>
<td>m³/10³T</td>
<td>45 ÷ 50</td>
<td>10 ÷ 12</td>
<td>30 ÷40</td>
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<td>Hydraulic prop per 1000 tons coal extracted</td>
<td>prop/10³T</td>
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<td>0,6 ÷ 0,8</td>
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<td></td>
<td>Explosives per 1000 tons coal extracted</td>
<td>kg/10³T</td>
<td>160÷180</td>
<td>160÷180</td>
<td>70÷80</td>
<td>150÷200</td>
<td>150÷200</td>
<td>200÷200</td>
<td>150÷200</td>
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<tr>
<td></td>
<td>Detonators per 1000 tons coal extracted</td>
<td>pcs/10³T</td>
<td>700÷800</td>
<td>700÷800</td>
<td>110÷150</td>
<td>400÷750</td>
<td>400÷500</td>
<td>80÷90</td>
<td>500÷800</td>
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<td></td>
<td>Steel grid per 1000 tons coal extracted</td>
<td>m²/10³T</td>
<td>-</td>
<td>-</td>
<td>120÷180</td>
<td>500÷700</td>
<td>500÷700</td>
<td>600÷700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emulsion per 1000 tons coal extracted</td>
<td>kg/10³T</td>
<td>-</td>
<td>180÷210</td>
<td>120÷150</td>
<td>15÷25</td>
<td>20÷25</td>
<td>150÷180</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preparatory roads per 1000 tons coal extracted</td>
<td>m/10⁵T</td>
<td>12÷14</td>
<td>8÷12</td>
<td>8÷12</td>
<td>15÷20</td>
<td>4÷6</td>
<td>3,2÷6,4</td>
<td>40÷50</td>
</tr>
<tr>
<td></td>
<td>Loss factor</td>
<td>%</td>
<td>30 ÷35</td>
<td>18÷22</td>
<td>15 ÷20</td>
<td>30 ÷35</td>
<td>15÷35</td>
<td>25÷35</td>
<td>25÷30</td>
</tr>
</tbody>
</table>

Table 3.2  Major technological and economical indexes in mining systems
(Adapted from Master plan of Vietnamese coal mining industry to 2020, outlook to 2030)
In addition to other hydrological geological conditions, most underground mines are affected by water from former (and also abandoned) underground excavation areas (during the French colonial era, from mines in the neighborhood and illegal excavation areas). Probe drilling for drainage is supported by the Japanese government and experts in all technology, equipment and knowledge\textsuperscript{232}.

Regarding methane gas explosion precautions, portable methane measurement tools are generally used widely. Additionally, there are 26 automatic observational centralized systems, mostly made in Poland. The systems will be installed in other underground mines in upcoming periods. The functions of the system are to measure methane gas density, air speed, volume of fume, and density of toxic gas, show the operation status of particular equipment and to transfer data to central observation systems on the surface\textsuperscript{233}.

In the technology, underground production and safety strategy of forthcoming years, Vinacomin raised priority programs for the (1) Mechanization and modernization in coal mines, and (2) Reduction and prevention of disadvantages of natural conditions in mining procedure for a safe production\textsuperscript{234}.

### 3.1.4 Features of the labor force

95 percent of the labor force in the Vietnamese coal mining industry is employed by Vinacomin, the rest works in the Steel Corporation and local coal mines – authorized by the Industry and Trade Departments of Provinces\textsuperscript{235}.

Due to the development of the coal mining industry, the labor force in this industry increased (Figure 3.2). After 7 years, as of 2010, the labor force was over 50 percent

\textsuperscript{232} V.T. Le, N.L. Pham (2011)
\textsuperscript{233} Q.H. Phung et al. (2010)
\textsuperscript{235} Mining Industry Investment Consultant Company Limited (2010), \textit{Chapter 5: State-of-the-art in coal production}
higher and the blue-collar work force grew 34 percent. At the end of September 2011, there were 67,159 workers working in undergrounds mines in Vinacomin.

There are 6 levels (6 as the highest) in the assessment of underground workers’ skills (and 7 levels for open-cast workers). By the end of 2009, more than half of them were categorized at medium and high levels and nearly one-third of them achieved good skills and high ability in their specific work fields.

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236 Personnel and Payroll Department, Vietnam National Coal, Minerals Industries Holding Corporation Limited (2011)

Figure 3.3  Quantity (number of workers) and proportion of level standards (1 – 7) of excavation workers in Vinacomin, 2009
(Data from the Master plan of Vietnamese coal mining industry to 2020, outlook to 2030)

Workers from 25 to 45 years old play a major role in Vinacomin. In this age group, adults “enjoy excellent or very good health”238, and muscle strength reaches its peak between ages 25 and 30239. These features can be seen as advantages of the labor force in the Vietnamese coal mining industry.

Figure 3.4  Number of excavation workers of different ages in Vinacomin in 2009
(Data from the Master plan of Vietnamese coal mining industry to 2020, outlook to 2030)

238 D. A. Louw et al. (1998), *Human development*, Kagiso Tertiary, Cape Town, South Africa, p. 483
However, most workers of Vinacomin come from rural areas with small-scale peasant background\textsuperscript{240}. Before starting their work in the mining industry, they are trained for 18 to 36 months in vocational training schools or colleges belonging to Vinacomin which there are no specific safety training courses\textsuperscript{241,242}. Thus, their safety competence is not sufficient, as they are not aware of potential risks at work\textsuperscript{243}.

3.2 State-of-the-art in risk management

3.2.1 Safety competence and accidents

As mentioned in the previous part, safety competence of workers in Vinacomin is so weak that team work is also impacted negatively by unsafe behavior. According to an assessment of Vinacomin safety managers, although a lot of measures have been implemented the workers on-site lack of motivation for effective occupational safety and health management\textsuperscript{244}.

The figures below\textsuperscript{245} illustrate this remark.

\textbf{Figure 3.5 Wrong position while transporting underground}

\textsuperscript{240} A.T. Nguyen (2011)
\textsuperscript{241} Hongcam Vocational training and college – a subsidiary of Vietnam National Coal, Minerals Industry Holding Corporation Limited, Annual training reports (Vietnamese)
\textsuperscript{242} Huunghi Vocational training and college – a subsidiary of Vietnam National Coal, Minerals Industry Holding Corporation Limited, Annual training reports (Vietnamese)
\textsuperscript{243} According to an independent interview by the author in seminars about occupational safety and health held in different collieries of Vinacomin (Halam, Vangdanh, and Company 86 Coal Company – main research objects of the thesis), experts and staff in those mines predicted that such duration is not enough to form industrial style of work and discipline habits.
\textsuperscript{244} C.N. Nguyen (2007), Safety management in coal mining – requirement of a new approach, Proceedings of the18\textsuperscript{th} National conference of technology and science in mining, p.6 – 9 (Vietnamese)
\textsuperscript{245} Vietnam National Coal, Mineral Industries Holding Corporation Limited (2011b), First semi-annual occupational safety and health assessment, assurance for safety program in the second semi-annual (Vietnamese)
Figure 3.6 Ignoring a “No entrance” sign

Figure 3.7 Working without a ladder

Figure 3.8 Unsafe working position
Therefore, between 2001 and 2012, the numbers of accidents in coal collieries were increasing in line with the development of underground output (Figure 3.11). In 2003 and 2011, the high fatality rate seemed to have been managed but the good results were not maintained, as in the following years the higher rate had returned.

In the occupational safety and health reports of Vinacomin, the causes of fatal accidents were recorded. Regarding geological category, the main reasons for fatal accidents between 2001 and 2009 were chamber collapse, gas and mine explosion and water inrush. These caused more than 80% of fatalities (Figure 3.12, 3.13). As stated in the previous part, categories of technical risks are interdependent, thus, it is
difficult for Vinacomin to have an overall view of the status quo in risk management if the managers just analyze the causes of risks by individual categories.

![Figure 3.1](image)

**Figure 3.11  Numbers of fatalities in collieries of Vinacomin (2001 – 2012)**

The human factor influences the high rate of incidents. Within 5 years, from 2005 to 2009, there were a total of 1,468 cases with 1,605 victims. Of these, fatal accidents represented less than 10 percent (6.88% of cases and 9.09% of fatalities), minor injuries represented less than 40 percent (38.15% of cases and 39.07% of injuries), and the rest were serious injuries.

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247 Q.H. Phung et al. (2010)

248 According to Joint Circular 14/2005/TTLT-BLDBXH-BYT-TLDDLĐVN among Ministry of Labor, Invalid and Social Affair, Ministry of Health, Vietnam General Confederation of Labor, issued in 8/3/2005 (Vietnamese), Article I point 2.2:

Fatal accident is: victim lost his life immediately at place of the accident, on the way to the emergency room, during the time of treatment, due to relapse of the injury by the accident itself within the time defined in §i, point 3.1, article II of this Circular (15 years).

Serious accident is: victim suffers from at least one of the injuries defined in appendix of this Circular (6 main categories: (1) head, face, neck; (2) chest, belly; (3) upper limb; (4) lower limb; (5) burns; and (6) seriously affected by toxicosis).

Minor accident is: victim suffers from none of the above.
Figure 3.12  Causes of fatalities in collieries from 2001 to 2009

<table>
<thead>
<tr>
<th>Year</th>
<th>Total of cases</th>
<th>Total of people</th>
<th>Minor Cases</th>
<th>Minor People</th>
<th>Serious Cases</th>
<th>Serious People</th>
<th>Fatal Cases</th>
<th>Fatal People</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>295</td>
<td>305</td>
<td>117</td>
<td>117</td>
<td>158</td>
<td>160</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>2006</td>
<td>297</td>
<td>340</td>
<td>117</td>
<td>137</td>
<td>156</td>
<td>163</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>2007</td>
<td>250</td>
<td>273</td>
<td>92</td>
<td>99</td>
<td>137</td>
<td>145</td>
<td>21</td>
<td>29</td>
</tr>
<tr>
<td>2008</td>
<td>306</td>
<td>352</td>
<td>108</td>
<td>140</td>
<td>178</td>
<td>182</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>2009</td>
<td>320</td>
<td>335</td>
<td>126</td>
<td>134</td>
<td>178</td>
<td>182</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>1468</td>
<td>1605</td>
<td>560</td>
<td>627</td>
<td>807</td>
<td>832</td>
<td>101</td>
<td>146</td>
</tr>
</tbody>
</table>

Table 3.3  Statistical data of injuries and fatal accidents in collieries from 2005 to 2009
(Adapted from Q.H. Phung et al., 2010)

249 Author’s note: As of 2010 and 2011 some categories of the accidents’ causes were different from the previous years’ in different reports, thus, data of 2010 and 2011 could not be illustrated in the two figures.
Accidents happened at the group levels 4/6 and 5/6, who were well-trained and experienced. Regarding human behaviors, personal thinking and low effects in communication among workers were pointed out as a cause of incidents and accidents in the annual reports of safety\textsuperscript{250}.

Also in these reports, the first shift (normally from 6 am to 2 pm) was the time when most of the accidents occurred. This is the coal production shift, which has the main duties of underground excavation (the main duties of other shifts are the consolidation of working conditions and supply of materials) and more than half of the accidents occurred in the latter 4 hours of the shift, when most of workers were tired\textsuperscript{251}.

3.2.2 At the corporate level

The structure of safety management in Vinacomin is illustrated in Figure 3.14\textsuperscript{252}.

The Chief Executive Officer (CEO) of the corporation organizes, coordinates, and is responsible for legal authorities and the Board of Directors on safety. The Safety Executive is the person directly in charge of safety, who manages and coordinates occupational safety and health programs throughout the entire corporation. The responsibility of the Safety Department is in occupational safety and health and it supports the General Director and Vice Director of Safety and guides and supervises safety programs in subsidiaries. As part of this system there are two proximate units for safety management under regulations of the government and the corporation, which are: (1) Mining Emergency Center, which has the major responsibilities of accident prevention, saving victims of accidents and dealing with accidents quickly and effectively, and coordinating in damages’ restriction; and (2) Mine Safety Center (member of a scientific subsidiary from Vinacomin – the Vietnam Institute of Mining Science and Technology) which has the major responsibilities of researching technological measures to prevent and control risks from mining gases, water inrush,

\textsuperscript{250} Vietnam National Coal, Mining Industries Holding Corporation Limited, Annual reports of incidents and accidents from 2008 – 2010 (Vietnamese)
\textsuperscript{251} Q.H. Phung et al. (2010)
\textsuperscript{252} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2009c), Occupational safety and health in coal mining industry (Vietnamese)
goaf, etc. as well as experimenting on safety aspects of underground equipment, industrial blasting materials and resistance of lining materials, etc.  

Similar to the safety management structure of the corporation, all underground mines have to organize a safety department under the authorities of the Mining Chief Executive and Mining Safety Executive, which runs a safety surveillance system on duty in all sites of all production units in every shift. In the production department, foremen and shift-supervisors have the duties of organizing safe production. In every shift, miners are set up in teams. The team-leaders are managers on the lowest level of the hierarchy. Generally in OSH management, higher-level managers on any management level are always responsible when incidents and/or accidents occur to the lower level staff members.

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Besides of the Vietnamese Labor Code\textsuperscript{254} and other decrees from other related organizations such as the Ministry of Labor, Invalid and Social Affairs, Ministry of Health, the Ministry of Industry and Trade, and the Vietnam General Confederation of Labor, regarding the legislative fundamentals of safety management in Vinacomin, since 2005 various documents have been issued. These following notices, directives and decisions offer guidelines for Vinacomin’s subsidiaries in the field of occupational safety and health.

Specific departments (Techniques and Excavation, Ventilation, Water Drainage, Personnel and Payroll, Safety etc.), the Labor Union, and the Youth Union are all involved in safety programs.

Between 2001 and 2010, Vinacomin had invested approximately 1,680 billion Vietnamese Dong (about 60 million Euros) in safety programs. This amount of money was as high as 0.705% of the corporation's revenue. In 2009 and 2010, the investment increased to approximately 700 billion Vietnamese Dong each year (26 million Euros), which was nearly 1% of revenue. In 2011, the prevention strategies of this corporation were mostly in 5 different fields (1) Safety measures and technologies relating to explosion protection; (2) Safety measures and technologies of working conditions and poison protection; (3) Protection equipment and improvement of working conditions; (4) Care of health and occupational diseases; and (5) Safety training programs and public relations measures\textsuperscript{255}, all of which accumulated up to 771 billion Vietnamese Dong (equal to 26.6 million Euros)\textsuperscript{256}.

Despite many administrative efforts, the consequences from incidents and accidents were categorized as being at high levels\textsuperscript{257}. According to Phung Q.H et al., these are the main reasons for the disadvantages in the safety management of the Vietnamese

\textsuperscript{254} Social Republic of Vietnam, the Labor Code was first issued in 23/6/1994, amended and supplemented on 24/2/2002. The Labor Code protects the right to work.; interests and other rights of workers and, at the same time, the lawful-rights and interests of employers thereby creating conditions for a harmonious and stable labor relationship. It contributes to releasing the creativeness and talent of both manual and intellectual workers, of labor managers, with the aim of achieving a high level of productivity and quality and social progress in labor, production and services, efficiency in the use and administration of labor; and contributes to the industrialization and modernization of the country, for the objective of prosperous people, a mighty country and a just, democratic, civilized society.

\textsuperscript{255} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2011c)

\textsuperscript{256} M.H. Hoang et al. (2012), \textit{Study on the establishment of the payment mechanism and the economic measures for engaging the workers' responsibility the labor safety}, Mining Technology Bulletin, Vol 1/2012, p. 23 – 27 (Vietnamese)

\textsuperscript{257} Q.H. Phung et al. (2010)
coal mining industry: (1) the physical disturbance of blasting, ventilation, roof-propping, installing equipment and the prevention of water inrush; and (2) Field managers and safety surveillance do not require workers to comply with technical standards, guidelines and internal regulations\textsuperscript{258}. The 2010 general assessment in annual occupational safety and health also stated that the surveillance force was one of the disadvantages in safety management due to its limited experiences and limited knowledge\textsuperscript{259}, and in some cases, even the avoidance of direct confrontation with workers due to factors separate from work\textsuperscript{260}.

Occupational safety and health assessments in Vinacomin investigate serious incidents and fatal accidents quarterly, semi-annually and annually. This information is discussed in meetings between corporation leaders and representatives from subsidiaries, to better understand these situations.

Vinacomin and the Mine Safety Center co-ordinate with underground mines to offer training programs on how to handle methane gas explosions (Figure 3.15, 3.16 and 3.17) to all underground mines. The experiments contain: (1) Safety standards in working and walking underground; (2) Ventilation; (3) Measurement and assessment of mine gas density; and (4) Safe usage of electronic equipment\textsuperscript{261}. Up to June 2010, about 80,000 workers attended these programs, which were held every two years\textsuperscript{262}.

Vinacomin also organizes many courses and seminars in their vocational training colleges and the human resources development training center. It is worth noting that within a period of ten months in 2011 there were 6 training courses offered with the support from Japanese experts\textsuperscript{263}.

\textsuperscript{258} Q.H. Phung et al. (2010), p.41
\textsuperscript{259} Vietnam National Coal, Mineral Industries Holding Corporation Limited (2011a)
\textsuperscript{260} Vietnam National Coal, Mineral Industries Holding Corporation Limited (2010d), Assessment of occupational safety and health in 2009, assurance for safety program in 2010 (Vietnamese)
\textsuperscript{261} Mining Safety Center (2011), Deployment of safety training and prevention from burning and explosion from methane gas and dust coal in underground mines, Mining Technology Bulletin, March 2011, p.2 (Vietnamese)
\textsuperscript{262} Q.H. Phung et al. (2010), p.54
\textsuperscript{263} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2010e), Decision 4626/TKV – LDTL: Agreement of the Corporation to the Huunghi Vocational training college – a subsidiary of the Corporation in organizing seminars and training programs in safety in collieries in Uong Bi – Mao Khe areas (Vietnamese)
Figure 3.15  Safety training and experiments on methane gas explosion in a model ventilated adit with a goaf section

Figure 3.16  Experiment on methane gas explosion in model vertical shaft; fire source in mouth of shaft

Figure 3.17  Experiment on coal dust explosion
Every two years, a safety and emergency contest is held for all subsidiaries. The contest covers theoretical tests (legal knowledge on occupational safety and health, specific knowledge) and practical tests (reaction in particular circumstances, test of fire emergencies first-aid, and emergency reactions underground\textsuperscript{264}).

The safety slogan of Vinacomin with regards to its companies working underground is currently: “Safety – Sustainability – Effect – Development”\textsuperscript{265}.

To build capacity in safety management in Vinacomin, some projects were conducted with foreign partners, for example the project with NEDO Japan (New Energy and Industrial Technology Development Organization) called “Capacity development in mining production”. Since 2001, 1,171 trainees were sent to Japan as part of different groups: management, mining, safety training, mining exploration, mining electronics, mining rescue, ventilation and water drainage. After the training programs, 374 trainees (equal to 31.93\% of those sent) were appointed to higher positions and bring updated knowledge to their works in terms of management and mining safety\textsuperscript{266}.

Every year Vinacomin sets “safety goals” for the Safety Department and other subsidiaries of the corporation\textsuperscript{267}. Financial incentives are offered, of which the highest rates reward safety in underground coal companies\textsuperscript{268}.

However, despite of many efforts, these programs have not been so effective. One of the reasons is the pressure of coal production. Vinacomin signs annual contracts with
coal mining subsidiaries. As workers are paid by their coal output, production pressures become significant to them\textsuperscript{269} and they ignore safety standards\textsuperscript{270} for temporarily increased productivity\textsuperscript{271}.

3.2.3 At the subsidiaries level

Safety management structure in coal mining companies can be seen as the demagnification of the Safety Department in Vinacomin with almost the same responsibility besides the concrete duties in occupational safety and health. At the subsidiaries level, mobile mine rescue brigades are organized. These brigades are able to relieve other mines if necessary\textsuperscript{272}.

Safety training in companies is organized in 3 different stages: (1) in-door training, (2) on-site training at the production unit, and (3) training at work by a senior worker\textsuperscript{273}. Normally, this training will be integrated in other training activities, and the whole procedure lasts 6 to 12 months, during which a three month stage of training on-site is carried out under the supervision of senior staff\textsuperscript{274}. According to the annual assessment of occupational safety and health, in case of incidents and accidents, workers and staff who violate safety standards must be retrained by taking safety training courses again\textsuperscript{275,276}.

Coal mining companies in Vinacomin assess risks quarterly and annually in meetings with the participants of relevant staff: Board of directors, foremen and heads of technical departments. Risks prevention plans are set up, covering technical issues, safety and ventilation management and are assessed and approved by the corporation.

\textsuperscript{269} Author’s note: Results from the individual survey of staff and workers in different mines, 100\% of interviewees who are foremen confirmed this situation.
\textsuperscript{270} Author’s note: Results from the individual survey of staff and workers in different mines, safety surveillance uncovered an elimination of 20 – 30\% manual manipulation and safety standards, thus, were also ignored to have more time on manual coal excavation.
\textsuperscript{271} M.H. Hoang et al. (2012)
\textsuperscript{272} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2007)
\textsuperscript{274} Vietnam National Coal, Minerals Industries Holding Corporation (2009b)
\textsuperscript{275} Duong Huy Coal Company (2010), \textit{Assessment report of occupational safety and health 2009, direction to 2010} (Vietnamese)
and mining emergency unit before implementation. According to the annual risk prevention plans, specific duties are delivered to teams which must perform them.\(^{277}\)

A serious issue is the number of staff who quit their jobs due to stress (both private and at work). According to A.T. Nguyen (2011), from 2008 to September 2010, there were 6,850 workers in underground mines that left their jobs.\(^{278}\) 80% of these workers are under the age of 30 and at skill level 3 and 4. Most of them live alone near the excavation areas, thus, far from their families (in rural areas). Accommodation and living conditions are quite unpleasant. Therefore, recently underground coal companies have built dormitories for miners, and/or recruit their spouses for service staff, in addition to improving other work support such as organizing buses to transport workers, supplying personal protective equipment, and organizing laundry facilities.\(^{279}\)

Internal safety contests are also held annually in all collieries in order to promote safety competence for workers, including theoretical questions and case study practices. In June 2011, Cao Thang Coal Company in Quang Ninh Province held a field trip for miners’ spouses to meet their partners at the mining site to broaden their understanding of miners’ jobs.\(^{280}\)

Underground entrance/exit controlling mechanisms are organized by the following: (1) Security guards at checkpoints pay close attention to and take note of workers’ entry; (2) Underground workers show their miner identification cards; (3) Chip cards and attendance readers are used at ports.\(^{281}\) None of the collieries have the technical capacity to identify work locations underground. Chambers nets in collieries are very complicated with main (incline) shafts, ventilation (incline) shafts, ventilation ports, and cross-seam transportation ports. Miners can get underground through this latter port and get out by the others. Thus, when incidents and accidents occur, it is difficult to identify the exact number of miners and their location for rescue.\(^{282}\)

\(^{277}\) Vietnam National Coal, Minerals Industries Holding Corporation Limited (2007)

\(^{278}\) A.T. Nguyen (2011)

\(^{279}\) Vietnam National Coal, Minerals Industries Holding Corporation Ltd (2011a) (Vietnamese)

\(^{280}\) Cao Thang Coal Company (2012), Annual report of Labor Union activities (Vietnamese)

\(^{281}\) Quang Hanh Coal Company (2010), Report of the Project “Investment in system of personnel controlling and positioning in tunnels of area I colliery Nga Hai” (Vietnamese)

\(^{282}\) Vietnam Institute of Mining Science and Technology (2009), Report of the Pilot Project “Installation of chip card system for personnel controlling and positioning in tunnels in collieries” (Vietnamese)
In 2010, a pilot project in Nga Hai colliery, Quang Hanh Coal Company installed of an entrance/exit underground control system. The aims of the system were to: (1) Control the entrance and exit of miners underground; (2) Observe underground personnel; (3) Improve production management; and (4) Support emergency rescue. This system was tested at coal faces on between a level of -50m to -100m of seams 12, 13, 14, and 15 since May 2010. After 7 months of the test, this system reached excellent technical results: good communication through a wireless calling system, efficient frequency chip card readers, efficient control of workers’ location underground, and smooth running of software. Therefore, Vinacomin planned to replicate this pilot project to the other collieries. However, till now, there has been no record of the replication in other collieries.

Regarding mine gas management, prior to 2005, two gas monitoring systems were installed in Mao Khe coal Company. The first one was made in Poland and installed in 2000; the second one was made in Japan and installed in 2003. Mao Khe coal Company was always evaluated to be superior in terms of methane gas exhaust, for example, with 15.64 m³ per ton of coal excavation per day in 2010. In 1999 there was a gas explosion in this company, and 19 miners were reported dead. These systems are now operating well, monitoring methane gas density in collieries and warning of potential explosions. However, explosions still happened in other collieries such as Thong Nhat coal Company (2006, 8 fatalities), Khe Cham coal Company (2008, 12 fatalities and 20 injured) etc. Therefore, in 2009 and 2010 other collieries completed the installation of mining gas monitoring systems with the cooperation of the Vietnam Institute of Mining Science and Technology. Thanks to these systems, self-burning coal seams and increased mining gas (in Hong Thai coal Company), high density of mining gas (in Ha Lam coal Company, Duong Huy coal

283 Quang Hanh Coal Company (2010)
287 Vietnam Coal Corporation (2006), Statistical data of incidents and accidents from 1998 - 2006 (Vietnamese)
288 T.B. Tran (2011)
289 Q.H. Phung et al. (2010)
Company, and No 35 coal Company) etc. could be recognized and plausible solutions to improve safety could be found\textsuperscript{290}.

### 3.2.4 At the production units level

The safety staff responsible for safety surveillance has the duty to workers when potential risks or threats are found. A function of the safety staff is to force workers to stop working when there are potential risks, until safety is restored\textsuperscript{291}. However, according to some experts, in some collieries the safety staff are young and recently graduated, and thus they lack experience in identifying potential risks. In some cases, repair demands of the safety staff were also ignored, as in Figure 3.18 which was mentioned in the semi-annual occupational safety and health assessment report\textsuperscript{292}: a ventilation pipe was torn and required repair.

![Figure 3.18 Ignorance of maintenance requirement: Torn ventilation pipe](image)

However, in collieries, sometimes accidents that cause no injuries might not be reported\textsuperscript{293}.

\textsuperscript{290} T.B. Tran (2011)
\textsuperscript{291} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2012c), \textit{Decision 641/QD- VINACOMIN} issued on 29/3/2012: \textit{Regulations of safety supervisors in underground coal excavation and underground construction in VINACOMIN} (Vietnamese)
\textsuperscript{292} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2011b)
\textsuperscript{293} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2011b)
3.3 Strategy of the Vietnamese coal mining industry

3.3.1 Production strategy at the corporate level

According to the master plan of the Vietnamese coal mining industry to 2020, outlook to 2030, open-cast mines will gradually be eliminated and underground excavation will be expanded. To 2030, 85% of coal outputs in Quang Ninh Province will come from underground mines. This is such a big challenge to Vinacomin in securing safety underground as well as recruitment.

The basic scenario of coal production in Vinacomin is approved by authorities such as the Ministry of Industry and Trade. Any adjustment in the production must be authorized.

<table>
<thead>
<tr>
<th>No</th>
<th>Mine/Field</th>
<th>Output (1000 tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>62115</td>
</tr>
<tr>
<td>I</td>
<td>North East coal basin</td>
<td>57215</td>
</tr>
<tr>
<td>A</td>
<td>Mines of Vinacomin</td>
<td>56915</td>
</tr>
<tr>
<td></td>
<td>Open-cast</td>
<td>23385</td>
</tr>
<tr>
<td></td>
<td>Underground</td>
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</tr>
<tr>
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</tr>
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<td>Open-cast</td>
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</tr>
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<td>Underground</td>
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</tr>
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</tr>
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<td></td>
<td>Open-cast</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Underground</td>
<td>3600</td>
</tr>
<tr>
<td>2</td>
<td>Mao Khe</td>
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<tr>
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<td>500</td>
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<td></td>
<td>Underground</td>
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</tr>
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<td>1100</td>
</tr>
<tr>
<td>4</td>
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<td>50</td>
</tr>
<tr>
<td></td>
<td>Underground</td>
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</tr>
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<td>Nam Mau</td>
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<td>Allowance for excavation</td>
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</tr>
<tr>
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<td><strong>Restriction area 5,2 km²</strong></td>
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<tr>
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<td>50</td>
</tr>
<tr>
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<td><strong>Underground</strong></td>
<td>1250</td>
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<td>Khe Chuoi – Ho Thien</td>
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<td>9</td>
<td>Dong Ri</td>
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<td>10</td>
<td>Quang La</td>
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</tr>
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</tr>
<tr>
<td></td>
<td><strong>Underground</strong></td>
<td>100</td>
</tr>
<tr>
<td>12</td>
<td>Dong Dang – Dai Dan</td>
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<tr>
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<td><strong>Underground</strong></td>
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</tr>
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</tr>
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<td>2</td>
<td>Nui Beo (Open-cast)</td>
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</tr>
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<td>Nui Beo (Underground)</td>
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<td>Ha Lam</td>
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<td>Suoi Lai (Open-cast)</td>
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<td>Cao Thang</td>
<td>800</td>
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<tr>
<td></td>
<td>Giap Khau</td>
<td>500</td>
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<tr>
<td></td>
<td>Productivity improvement</td>
<td></td>
</tr>
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<td>Ha Rang</td>
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</tr>
<tr>
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<td><strong>Open-cast</strong></td>
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</tr>
<tr>
<td></td>
<td><strong>Underground</strong></td>
<td>850</td>
</tr>
<tr>
<td>A</td>
<td>Ha Rang</td>
<td>700</td>
</tr>
<tr>
<td>B</td>
<td>West Nga Hai and Da Bac</td>
<td>150</td>
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<tr>
<td>8</td>
<td>Binh Minh</td>
<td>1100</td>
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<td>1100</td>
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<tr>
<td></td>
<td><strong>Other areas</strong></td>
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<td>Tan Lap</td>
<td>500</td>
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<td>A.3</td>
<td><strong>Cam Pha area</strong></td>
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<tr>
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<td>15375</td>
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<td>2</td>
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<td>---</td>
<td>----------------------------</td>
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</tr>
<tr>
<td>3</td>
<td>Coc 6</td>
<td>3600</td>
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<td>Open-cast</td>
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<td>Open-cast</td>
<td>200</td>
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<td>North Quang Loi</td>
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<td>8</td>
<td>North Quang Loi (underground)</td>
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<td>9</td>
<td>North Coc 6 (shaft)</td>
<td>1000</td>
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<td>10</td>
<td>Northern West Khe Cham</td>
<td>50</td>
</tr>
<tr>
<td>11</td>
<td>Khe Cham I (underground)</td>
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<td>12</td>
<td>Khe Cham II</td>
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<td>Khe Cham III (shaft)</td>
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</tr>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Underground</td>
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</tr>
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<td>16</td>
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<td>18</td>
<td>Western North Nga Hai</td>
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</tr>
<tr>
<td></td>
<td>Underground</td>
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</tr>
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<td>19</td>
<td>Northern East Nga Hai</td>
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<tr>
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<td>Open-cast</td>
<td>350</td>
</tr>
<tr>
<td>B</td>
<td>New mines</td>
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<td></td>
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<td>300</td>
</tr>
<tr>
<td>1</td>
<td>Bao Dai I</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Bao Dai III</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Dong Trieu Pha Lai I</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Dong Trieu Pha Lai II</td>
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</tr>
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<td>6</td>
<td>Dong Trieu Pha Lai III</td>
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</tr>
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<td>7</td>
<td>Dong Trieu Pha Lai IV</td>
<td></td>
</tr>
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<td>8</td>
<td>Cuoc Be</td>
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### Table 3.4 Basic scenario of development in Vinacomin

<table>
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<tr>
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<th>East Quang Loi (East Mong Duong)</th>
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<td>2950</td>
<td>3050</td>
<td>3050</td>
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<tr>
<td>III</td>
<td>Others (non-Vinacomin)</td>
<td>1950</td>
<td>2050</td>
<td>3550</td>
</tr>
</tbody>
</table>

#### 3.3.2 Strategy of collieries (Vang Danh, Ha Lam, Coal Company 86)

The two coal companies Vang Danh and Ha Lam have established their own strategies under the Master plan of development to 2020, outlook to 2030 of Vinacomin. Company No. 86 is a third-level company of Vinacomin, under the Dong Bac Coal – Mineral Investment Corporation. The development strategy of Coal Company 86 is a part of the Dong Bac Coal – Mineral Investment Corporation.

Vang Danh (Vang Danh Coal Joint Stock Company) is the biggest colliery in Vinacomin. It was established in 1964 and became a joint stock company in 2008. In addition to the 20 management departments, there are 24 departments of excavation and digging, and more than 10 support departments. According to Vinacomin’s planning, this company will reach 4.5 million tons of underground output (raw excavation) in 2015, 5 million tons in 2020 and maintain the capacity of 5 million tons per year to 2030 (10% of Vinacomin’s output). The excavation area is about 20 km², at two levels: between +122 m and -175m (Vang Danh part), and between +115m and -220m (Canh Ga part). Using long-pillar mining in excavation with single hydraulic props and mobile hydraulic prop-shields, Vang Danh is also successfully applying VINAALTA automatic hydraulic prop-shields (domestic products). Coal is transported outside by conveyor-belts and drag conveyors. Soil and materials are transported by 3-ton wagons on 900 mm-wide railways. Ventilation is located in the central station inlet in ventilation adits.

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284 Mining Industry Investment Consulting Company Limited (2010), Master plan for the development of the Vietnamese coal mining industry to 2020, outlook to 2030, Chapter 11: Master plan of coal excavation (Vietnamese)
285 Mining Industry Investment Consulting Company Limited (2010), Chapter 11: Master plan of coal excavation (Vietnamese)
288 Mining Industry Investment Consultant Company Limited (2010), Chapter 11: Master plan of coal excavation p. 8 (Vietnamese)
Ha Lam (Ha Lam Coal Joint Stock Company)\textsuperscript{299} will close their open-cast excavation area in 2015 after maintaining an output of 500 – 1,250 thousand tons per year. According to the master plan of Vinacomin, the output will reach 2.4 million tons in 2020 and 3.5 million tons per year from 2022\textsuperscript{300} (approximately 37\% of Halong area’s output). Besides from the current underground mining, most of the coal output of this company will come from the excavation in the deepest shaft in Vietnam, with a depth of -345m in the main shaft\textsuperscript{301}. Ha Lam is classified as less dangerous for methane gas with a methane density of 0.90 m\textsuperscript{3} per ton of coal excavation per day\textsuperscript{302}.

### 3.3.3 General strategy of safety management\textsuperscript{303}

The summary of the Vietnamese coal mining industry’s strategy of safety management involve 3 major parts: (1) education and training; (2) technology renovation; and (3) technology management.

**Towards education and training.** These were discussed firstly in the master plan of safety management. The updating and upgrading of curricular and training methods in Vinacomin’s vocational training schools are considered significant issues. They are needed to establish subjects related to safety in training programs for mining engineers for the development of the Vietnamese coal and minerals industries\textsuperscript{304, 305}.

From the laws and regulation issued by the government or other ministries (such as Ministry of Industry and Trade, Ministry of Labor, Invalid and Social Affairs), Vinacomin will issue plausible standards for miners in the fields of skills, knowledge, health, and safety competence, improving not only human resources but also the ability of workers to adapt to developments in the industry in forthcoming

\textsuperscript{299} Official website of Ha Lam Coal Joint Stock Company http://halamcoal.com.vn/
\textsuperscript{300} Mining Industry Investment Consulting Company Limited (2010), *Chapter 11: Master plan of coal excavation* p. 30 (Vietnamese)
\textsuperscript{301} Ha Lam Joint Stock Coal Company (2009), *Project “Coal excavation in the reserve under level -50m”* (Vietnamese)
\textsuperscript{302} Q.H. Phung et al. (2010)
\textsuperscript{303} Mining Industry Investment Consulting Company Limited (2010), *Chapter 18: Master plan of safety management* (Vietnamese)
\textsuperscript{304} X.T. Khuong (2007), *Education of safety mining engineers*, Proceedings of the 18\textsuperscript{th} National conference of technology and science in mining p. 79 – 83 (Vietnamese)
\textsuperscript{305} T.C. Nguyen et al. (2007), *Direction of safety measures in master plan of Vietnamese coal mining industry from 2006 to 2015, outlook to 2025*, Proceedings of the 18\textsuperscript{th} National conference of technology and science in mining p. 74 – 78 (Vietnamese)
years. Furthermore, Vinacomin are improving collaboration among the Labor Union, Youth Union and other authorities for more effective safety in mining production\textsuperscript{306}.

**Towards technical renovation** in collieries. Vinacomin plans to invest in probe drilling to control water inrush and drainage, and geological changes (faults, broken ground, and old adits), to prevent water inrush and gas ejection. Vinacomin also plans to install standard equipment to protect explosion mines from high densities of methane gas\textsuperscript{307}. The renovation is a priority of Vinacomin to 2020, including two programs: (1) mechanization and modernization in coal and minerals enterprises, and (2) prevention of disadvantages of natural conditions and mining excavation for safe production\textsuperscript{308}.

**Towards technical management.** Designs, technical regulations, construction methods, safety methods in production, transport and ventilation will be checked and reviewed. Prevention from methane explosion will be monitored by ventilation mode and mining gas control under regulation of the National technical regulation for safety in underground coal excavation\textsuperscript{309}. Mining gas (CH\textsubscript{4}, CO\textsubscript{2}, CO) will be controlled by portable optical gas meters, electronic gas meters, individual methane gas warnings, and sensor alerts before beginning a new shift, and especially after Sundays or holidays. Workers are allowed to go underground only when ventilation and mining gas are controlled and at safety assurances. Entry to underground must be controlled all day. Underground equipment must be periodically inspected. Prevention from water or mud inrush is undertaken by reviewing geological documents with updated information and application of modern drilling methods. Industrial explosives must be safely controlled in all stages of production, consumption and preservation, etc\textsuperscript{310}.

\textsuperscript{306} Mining Industry Investment Consulting Company Limited (2010), *Chapter 18: Master plan of safety management* (Vietnamese)
\textsuperscript{307} Mining Industry Investment Consultant Company Limited (2010), *Chapter 18: Master plan of safety management* (Vietnamese)
\textsuperscript{309} Ministry of Industry and Trade (2011)
\textsuperscript{310} Mining Industry Investment Consultant Company Limited (2010), *Chapter 18: Master plan of safety management* (Vietnamese)
In other activities for safety assurance, Vinacomin plans to supply all the staff with personal prevention equipment, and maintain good working conditions\textsuperscript{311}.

However, it is insufficient of the master plan that no concrete measures were planned to achieve the set targets.

### 3.4 Challenges in risk management

In order to show the Vinacomin’s commitment to achieving the “Zero-accident” target in forthcoming years a routine with detailed timeline and concrete contents must be created.

As miners get used to working in large teams, safety, discipline and solidarity are becoming important aspects. Not only workers benefit from an adequate risk management system, but also enterprises and the mining industry as a whole. Damages and fatalities could be detected to eliminate compensation costs, and other costs for recovery\textsuperscript{312}.

The data in table 3.4 shows the quantity of excavations in Vinacomin’s underground mines in the forthcoming years. In order to maintain effective and sustainable development, Vinacomin should not only invest in mechanized technology but also focus on risk management, especially in deep underground excavation.

Occupational safety and health is a major risk field (Figure 1.4). It must be seen as an integral part of the company’s risk management system due to its vital importance in achieving strategic company targets. Proper risk prevention means avoiding harm to people and helping a company increase its productivity and performance\textsuperscript{313}.

From the state-of-the-art in risk management in Vinacomin, it can be seen that the main challenges in sustainable development of the Vietnamese coal mining industry are to rectify the inadequacies and asynchronicities in many areas, such as (1) in laws, regulations\textsuperscript{314}, risk management outlines and technological norms\textsuperscript{315}; (2) in

\textsuperscript{311} T.C. Nguyen et al. (2007)
\textsuperscript{312} J. Kretschmann, N. Nguyen (2011a)
\textsuperscript{313} J. Kretschmann, N. Nguyen (2011a)
\textsuperscript{314} D.T. Dao, T. Tsugunori (2007), \textit{Suggestion for model of organizational safety management system for Vietnamese coal mining industry}, Proceedings of the 18\textsuperscript{th} National conference of technology and science in mining, p. 55 - 59 (Vietnamese)
technical equipment; (3) in organizational and operational procedures; (4) in safety awareness among employees – for the lack of safety culture and sufficiently qualified employees, which also leads to the situation of (5) the pervasive phenomenon of temporary and non-committal compliance or a preference for form over substance, and (6) the pressure from the board to increase the production.

In table 3.3, among these cases, serious incidents occupy the highest rate. According to E. Hollnagel (2009), the Heinrich’s Law states that “in a workplace, for every accident that causes a major injury, there are 29 accidents that cause minor injuries and 300 accidents that cause no injuries” (Heinrich’s 300 – 29 – 1 ratios). Hence accidents that cause no injuries might not be fully reported. Incomplete statistical data is also a consequence of information ignorance. In a survey of the author in Coal Company 86 in a seminar in 2011 to safety staff, engineers and foremen in this company stated however, that every month and quarter, shift-supervisors (assistant foremen) report incidents to improve the vigilance of workers underground, and to ensure that no authorities’ warnings are ignored. Kletz (1976) in his writing pointed out that to blame human error for accidents is as superficial and unhelpful as to blame gravity for falls. Myers (2012) also confirmed that the majority of major hazard incidents happen because of human management failures. Personal measures, therefore, will be root solutions for effective risk management. At the workers’ level, low safety competence, lack of skills in industrial fields, weak motivation for safety compliance except for monetary aspects and other cultural factors are barriers to permanent compliance with safety regulations or engagement in other safety campaigns.

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315 J. Kretschmann, N. Nguyen (2011a)
316 T.C. Nguyen et al. (2010)
317 C.N. Nguyen (2007)
318 J. Kretschmann, N. Nguyen (2012a), Successful implementation of the German risk management system in occupational safety and health to South East Asia – cultural conditions and challenges, Presentation at the 23rd annual general meeting of mining professors, Wroclaw, Poland, July 2012; Proceedings of the 2nd international conference on advances in mining and tunneling, Hanoi, Vietnam, August 2012, p. 202 - 206
319 J. Kretschmann, N. Nguyen (2011a)
320 E. Hollnagel (2009), Safer complex industrial environments: a human factors approach, CRC Press, p.163
321 T. Kletz (1976), A three pronged approach to plant modifications, Chemical Engineering Process, p. 70 - 76
Although the Vietnamese coal mining industry highlights the role of education and training in the establishment and enhancement of safety competence in this industry\textsuperscript{323,324,325,326,327,328,329,330}, it is only “lip-service”\textsuperscript{331} if there are no comprehensive changes, in different levels of hierarchy in the corporation, subsidiaries, and production units, both in theory and practice.

Returning to the German experience in the coal mining industry, safety management was initatively conducted by technical measures from machinery, methods and equipment. Within a period of 30 years, the German coal mining industry reduced the death toll from 416 fatalities in the 1960s, to 30 fatalities in the 1990s. As a second step, organizational measures were introduced to carry out adjustments in structures, processes and systems, which have helped reduce the number of accidents per 1 million working hours from 95 to 24, and the death toll to 6 in the year 2000. In 2010, there were no fatal accidents and the rate of accidents per 1 million working hours is approaching to zero as RAG implemented employee-related measures, such as qualifications through training courses, briefings and management development\textsuperscript{322}. And the low rates of incidents and accidents require commitment and insistence on the goal of “zero-accidents”.

The Vietnamese coal mining industry also aims to reach “zero accidents” in mining excavation\textsuperscript{333}. In fact, in 2011 the fatal accidents that had many fatalities in underground excavation were less than half the number in 2010\textsuperscript{334}. Through training and education, safety management can be improved. Risk management should be

\begin{itemize}
\item \textsuperscript{323} C.N. Nguyen (2007)
\item \textsuperscript{324} T.C. Nguyen (2007)
\item \textsuperscript{325} V.D. Vuong, V.T. Le (2007), \textit{Overview of occupational safety and health in collieries excavation, suggestion of technical measurement and management to minimize accidents in the Vietnamese coal mining industry}, Proceedings of the 18\textsuperscript{th} National conference of technology and science in mining, p. 209 - 215 (Vietnamese)
\item \textsuperscript{326} T.B. Tran, C.C Pham (2007), \textit{Fundamental strategies in preventing methane gas combustion and explosion in underground excavation}, Proceedings of the 18\textsuperscript{th} National conference of technology and science in mining, p. 255 - 260 (Vietnamese)
\item \textsuperscript{327} Q.H. Phung et al. (2010)
\item \textsuperscript{328} Mining Industry Investment Consultant Company Limited (2010), \textit{Chapter 18: Master plan of safety management} (Vietnamese)
\item \textsuperscript{330} J. Kretschmann, N. Nguyen (2011a)
\item \textsuperscript{331} J. Kretschmann, N. Nguyen (2011a)
\item \textsuperscript{332} D. Mantwill (2011)
\item \textsuperscript{333} C.N. Nguyen (2007)
\item \textsuperscript{334} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2011c)
\end{itemize}
integrated in conferences, workshops, seminars and education training programs in colleges, companies and workplaces. By renewing education and training as well as retraining methods in universities and colleges, motivation for risk management could be instilled in managers and workers leading to more safety. The transference of the risk management system from the German coal mining industry to Vietnam should take place through changes in training: participatory training methods, and the content of safety training programs. Participatory training methods and modules are quite popular in German training seminars, initially inspiring attendance and then active participation in learning, understanding and implementation.

335 J. Kretschmann, N. Nguyen (2011b)
336 J. Kretschmann, N. Nguyen (2011b)
337 Bergwerk Ost (2010), Ausbildung nimmt am Projekt zur Unfallprävention teil, Steinkohle 05 /2010
338 M. Füllemann (2011), The four steps to behavior changes: The role of management, Presentation at Workshop on safety culture, risk management, competence and training, Quang Ngai, Vietnam, March 2011
339 N. Nguyen (2011a), Participatory training method can be applied in safety training courses in the Vietnamese coal mining industry, Mining Industry Journal, December 2011(Vietnamese)
4 Transference of the risk management system in the German hard coal industry to Southeast Asia

Southeast Asia is comprised of 11 countries, Brunei, Indonesia, Cambodia, Laos, Malaysia, Myanmar, Singapore, Thailand, Vietnam, the Philippines and Timor-Leste\(^{340}\).

![Map of Southeast Asian countries](image)

**Figure 4.1** Map of Southeast Asian countries\(^{341}\)

Coal is currently produced in most of these countries, except Brunei, Cambodia, Singapore, and Timor-Leste. In 2011, Indonesia was the largest producer in the area (total production of 637,143 thousand short tons), followed by Vietnam (49,774)\(^{342}\), Thailand (23,744), the Philippines (7,939), Malaysia (2,851), Myanmar (1,598) and Laos (741)\(^{343}\).

Southeast Asian countries have reached different levels in risk management\(^{344}\). Most of these countries are in case 2 (Figure 2.11) with high willingness but very low capacity in risks management and mining industries have the highest rate of fatalities\(^{345}\). To enhance the ability to handle risks, it is necessary to educate and

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\(^{340}\) Official website of the Association of Southeast Asian Nations (ASEAN): http://asean.org

\(^{341}\) Official website of the Association of Southeast Asian Nations (ASEAN): http://asean.org

\(^{342}\) Author’s note: this data might be included of the coal excavation from other companies that are not member of Vinacomin.


\(^{344}\) J. Kretschmann, N. Nguyen (2011b)

\(^{345}\) J. Kretschmann, N. Nguyen (2011b)
train, as well as to provide strong, satisfactory solutions in dealing with risks. This is also recommended by the International Association of Labour Inspection (IALI), when they come to the conclusion “there are no new accidents, just new people repeating the same old mistakes”. The question “why not invest in sharing and learning” is then raised, as well as advices of “effective risk management is not just technical solutions”, and “learning of lessons before incidents occur”.

Mining is one of the most hazardous and dangerous industries in Southeast Asia. Different levels in risk management in Southeast Asian countries are derived from different economic developments. Task forces and national OSH programs have already been established. Southeast Asian countries face challenges especially in OSH legal frameworks such as creating stand-alone OSH laws, extending coverage of OSH laws and regulations, developing OSH provisions in easy-to-understand language for employers and workers as well as applying international standards.

Common codes for occupational safety and health in Southeast Asian countries are difficult to reach; however, in the field of occupational safety and health, these countries are making an effort to promote their own network of ASEAN-OSHNET, based on the International Labour Organization’s program for the improvement of working conditions.

### 4.1 Prerequisites of transference

The transference of the risk management system in the German hard coal industry to Southeast Asian countries should be based on education and training. Effective

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346 J. Kretschmann, N. Nguyen (2011b)
347 Official website http://www.iali-aiit.org/en/about.htm: The International Association of Labor Inspection (IALI) is the global association for labor inspection. It was established in 1972, and currently has over 100 members worldwide (information from 2012). The main aims of IALI are: (1) To promote the professionalism of its members in all aspects of labor inspection, so as to enhance their impact and effectiveness; (2) To hold international and regional conferences and similar events at which members can exchange ideas and experience about how to best promote compliance with labor law and good practice; (3) To provide information to its members about professional issues through the Association’s website, newsletters, reports and other publications; and (4) To promote closer collaboration between its members, through regional networking and activities.

348 K. Myers (2012)
350 J. Kretschmann, N. Nguyen (2011b)
351 J. Kretschmann, N. Nguyen (2012a)
education and training requires integration along different levels: strategic and national programs, conferences, workshops, seminars held by the mining industry or related ministries, and education training programs in colleges, companies and workplaces. This is considered the multi-level approach\textsuperscript{352,353} and one of the prerequisites of transference.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure4.2.png}
\caption{The transference of the risk management system from the German hard coal industry to Southeast Asia by multi-level approach (Adapted from J. Kretschmann and N. Nguyen, 2012a)}
\end{figure}

The multi-level approach should be applied to companies. Generally, to upgrade the situation of Southeast Asia countries from case 2 (Figure 2.11) to case 1 (high willingness and ability), there must be transference of knowledge and technology, supported by financial conditions and incentives\textsuperscript{354}. Thus, there should be an integrated management system to improve OSH on the different levels of the corporate structure. Different levels of management positions and responsibilities require different activities to improve the effectiveness of OSH programs.

For the effectiveness of risk management and safety programs in Southeast Asia, there should be international networks and close collaboration among countries\textsuperscript{355}. To date, there are two international networks which have not yet been interlinked.

\textsuperscript{352} J. Kretschmann, N. Nguyen (2011b)
\textsuperscript{353} J. Kretschmann, N. Nguyen (2012a)
\textsuperscript{354} J. Kretschmann, N. Nguyen (2011b)
\textsuperscript{355} J. Kretschmann, N. Nguyen (2011b)
The ASEAN-OSHNET is a forum for experts in occupational practice from state institutions to labour organizations. The academic community for human resource development is the Southeast Asia Engineering Education Development Network within the ASEAN University Network (AUN-SEED). Both networks deal with occupational safety and health but focus on different aspects. In order to develop strategies and practices for occupational safety and health, these two networks should work cooperatively.

![Multi-level approach to enhance willingness and safety competence](image)

**Figure 4.3** Multi-level approach to enhance willingness and safety competence
(Adapted from J. Kretschmann and N. Nguyen, 2011b)

In colleges, the philosophy and theory of risk management helps to create an understanding about the necessity to improve safety at work. In vocational colleges, basic courses on risk management should be offered to workers regularly.

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356 Official website of ASEAN – OSHNET: http://www.aseanoshnet.org/: The network aims to manage research and training for the improvement of working conditions and environment, with the mission to increase awareness, knowledge and skills in OSH for all concerned parties, and accelerate the freedom of OSH professionals and other services in the region, realizing the vision of a partnership in dynamic development as stated in the ASEAN Vision 2020 statement.

357 Official website of AUN-SEED: http://www.seed-net.org/info.php: To 2012 the network aims to establish a sustainable framework and network of human resource development in the field of engineering, aiming at contributing to the ASEAN region’s development, under the ownership of the member countries with the following outputs: (1) capacity enhancement of the member institutions, (2) collaborative research for industry and community, (3) further strengthening of engineering networks, and (4) preparation for the Japan – ASEAN graduate school consortium of engineering.

358 J. Kretschmann, N. Nguyen (2011b)

359 J. Kretschmann, N. Nguyen (2011b)
Contributions from the government should include (1) promoting a safety culture, (2) setting adequate codes and regulations with powerful sanctions, (3) implementing precise evaluations by independent authorities, (4) improving scientific knowledge of the mutual effects on economy and ecology, and (5) setting up networks for scientists, governments, NGOs, research centres and international institutions\(^{360}\).

At the corporate level, some campaigns should be conducted, to (1) concentrate on the enhancement of willingness and safety competence, (2) set up objectives and incentives for safety programs, (3) promote the company’s safety culture, and (4) implement and optimize OSH planning. At the lower level, the main activities include (1) invest in OSH, (2) develop schedules of responsibilities, manuals, guidelines etc., (3) conduct quality management measures and improvement programs, (4) implement safety training programs, (5) transfer know-how and exchange information, and (6) improve the effectiveness of risk management\(^{361, 362}\), by implementing quality management, procedures and discussions.

At the departmental level, aside from supplementing safety outfits and personal preventive equipment (PPE), and other activities to improve OSH, processing regular reports from the “bottom up” (lower levels) is also necessary\(^{363}\), due to the importance of feedback\(^{364}\). Managers and workers should be motivated to actively and initiatively discuss potential risks and their treatment\(^{365}\).

In the production units, the safety training programs should be conducted continuously. In parallel with these programs is the implementation of continuous quality management in occupational safety and health. Workers must be trained to understand and accept rules and regulations, for example: wearing safety outfits and equipment, or strictly implementing working procedures. It is also crucial to report

\(^{360}\) J. Kretschmann, N. Nguyen (2011b)
\(^{361}\) J. Kretschmann, N. Nguyen (2011b)
\(^{362}\) N. Nguyen, J. Kretschmann (2012a), *Risk communication in coal mining companies*, Presentation at the 6\(^{th}\) International conference on earth resources technology, Songkhla, Thailand, May 2012; Proceedings of the 2\(^{nd}\) international conference on advances in mining and tunneling, Hanoi, Vietnam, August 2012, p.181 - 186
\(^{363}\) J. Kretschmann, N. Nguyen (2011b)
\(^{365}\) J. Kretschmann, N. Nguyen (2011b)
risks in the workplace. Training programs involving participatory training methods should be held regularly.\textsuperscript{366}

As risk management is a part of strategic management, and an integral management function, the other prerequisite of the transference requires \textit{the integration of the risk management system in two directions, top-down and bottom-up}.\textsuperscript{367}

\section*{4.2 Transference at the national level}

At the national level, OSH frameworks need to be developed into standards and laws. In Southeast Asia, OSH has been issued in 5 countries (Cambodia, Indonesia, Laos, Thailand, and Vietnam), and independent OSH laws in 4 other countries (Brunei, Malaysia, the Philippines and Singapore).\textsuperscript{368} However, the effects of these laws on daily business in general are still disadvantageous (for instance, in 2010 the accident rate in Malaysia was 6.45/1,000 workers\textsuperscript{369}, and in 2011 in Vietnam it was 29.84/100,000 workers\textsuperscript{370}). A plausible law like KontraG which contains an early warning system, internal monitoring system, and risk control (Figure 2.4) should certainly be applied in Southeast Asian countries.

Also at this level, some reforms are recommended. For better social insurance, a lesson from Germany is the requirement to have accident insurance\textsuperscript{371}. This insurance covers (1) occupational accidents; (2) commuting accidents; and (3)

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{366} J. Kretschmann, N. Nguyen (2011b)
\item \textsuperscript{367} J. Kretschmann, N. Nguyen (2011b)
\end{itemize}
\end{footnotesize}

Available online at http://www.issa.int/content/download/126667/2589538/file/02_Hesse-Spoetter.pdf

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occupational diseases\textsuperscript{372}. Based on the experience of Germany, Southeast Asian countries are also trying to build a compensation fund for workers\textsuperscript{373}.

Reporting incidents and accidents should be a requirement. In the German hard coal industry, it is mandatory for companies to report any incident to the Government Safety Organization, so that the organization can collect knowledge of all insured cases and the costs of insurance\textsuperscript{374}. Furthermore, joint data bases and data exchange between provinces and accident insurance companies could be the basis for better supervision by regional authorities\textsuperscript{375}. It requires collaboration from different authorities for credible effects at the national level.

The International Social Security Association (ISSA) is also broadening their global strategies for risk management by collaborating with Southeast Asian countries at the national level through: conferences and workshops with foreign experts from Southeast Asian countries, Germany and other EU countries, and ILO etc. Global strategies include the “seven golden rules” for safe and economical mining\textsuperscript{376}, organizing independent mine safety audits and safety management system\textsuperscript{377}.

\textsuperscript{372} M. Hesse – Spötter (2010)
\textsuperscript{375} U. Meesmann (2012), German national occupational safety and health strategy – first results and outlook on the 2013 – 2018 period, Presentation at the International conference on occupational safety and health and the 2\textsuperscript{nd} ASEAN labor inspection conference: Promoting decent work: Occupational safety and health, preventions and labor inspection – challenges and solutions, Dong Nai, Vietnam, March 2012
\textsuperscript{376} International Social Security Association (ISSA), the Section on Prevention in the Mining Industry (2012), 7 golden rules for safe and economical mining: (1) Leadership and commitment; (2) Identify hazards and risks; (3) set safety and health targets; (4) ensure a safe system; (5) use safe and healthy technology; (6) control and improve qualification and knowledge of your staff; and (7) invest in your most valuable capital: motivate your employees.
4.3 Transference at the corporate level

4.3.1 The “seven golden rules”

The so-called “seven golden rules” to improve OSH recommended by the ISSA can be developed at the corporate level in a general handbook for the whole company. Companies using these rules, according to H. Ehnes (2011), have received excellent feedback from international OSH experts. The rules are presented by questions to companies as the starting point to systematically reduce accidents.

- Rule 1: Leadership and commitment:
  - Did you make safety and health your top priority?
  - Do your managers and employees know of your priority?
  - Are you setting an example in respect to OSH?
  - Do you instantly react to unsafe conditions or behavior?

- Rule 2: Identify hazards and risks:
  - Do you carry out a systematic risk assessment?
  - Do you include maintenance, repairs and procedures for unplanned interruptions?
  - How often do you update your risk assessment?

- Rule 3: Set safety and health targets:
  - Do you have written OSH policies?
  - Do you have a reliable reporting system on work accidents, occupational diseases and near misses?
  - Do you systematically evaluate your OSH statistics?
  - What are your OSH targets?
  - How do you investigate and evaluate work accidents?

- Rule 4: Ensure a safe system:
  - Do you have a certified safety management system?
  - Do all your managers (top level, medium level, lower level) know about their personal responsibility and duties for OSH?
  - Do you have written documents for the delegation of employer’s duties?
  - Do you have a clear organizational structure for OSH?

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378 H. Ehnes (2011)
Do you have required OSH-competence (physicians, safety specialists, specialized experts etc.) in your company?

Do you prepare and update the necessary plans and documents to run your mine safely, even for emergencies?

Do you have OSH-committees in your company?

Do you and your managers inspect all your workplaces regularly?

- Rule 5: Use safe and healthy technology:
  
  Do you consider OSH-matters when ordering new machinery or plant?

  Do you use efficient measuring equipment, to control flammable and respirable dust, gas and air?

  Do you use “state-of-the-art” technology, to prevent, control and extinguish mine-fire or dust-explosions?

  Do you use all machines in a safe way and regularly check safety installations?

  Do you care for a safe mine access and egress?

  Do you care for a safe support of the roof and of the walls?

- Rule 6: Control and improve qualification and knowledge of your staff:

  Is mining education available for every miner?

  Do you define the necessary qualification for each workplace?

  Do you have a plan for training and instruction?

  How do you document regular instructions?

  Do you consider communication problems such as language problems or illiteracy?

- Rule 7: Invest in your most valuable capital: motivate your employees:

  Are your employees involved in the company’s OSH-policies?

  Do you collect your employees’ ideas for improved safety systematically?

  Do you encourage your employees to report near misses and incidents?

  Do you practice open communication and information policies?

  Do you acknowledge good safety performance?
Due to Vinacomin’s state-of-the-art risk management and OSH system, implementation of evaluation measures to these questions is necessary.

By answering these questions, companies like Vinacomin can find out the strengths and weaknesses of their current OSH and risk management and plan improvements. Consequently, they can integrate OSH improvement measurement into corporate missions and goals, and reduce the production pressure by implement the so-called “safety first” principle, etc.

4.3.2 The handbook for occupational safety and health and risk management

To companies like Vinacomin, a handbook for OSH and risk management is a significant document, as there have previously been no guidelines or regulation. From the ILO regulations, the “golden rules” of the ISSA, and risk management handbook or OSH handbook of preceding coal mining industries, a company can suggest some basic requirements in the writing of their own handbook which other companies can use to their advantage.

For example, Vinacomin can offer the handbook of OSH to subsidiaries and the risk management handbook at the corporate level. In this way, concrete duties can be assigned to staff.

![Diagram of Two stages of the risk management handbook’s deployment in Vinacomin](image-url)
4.4 Transference at subsidiaries’ level

Subsidiaries can also organize different programs and measures that are related to the corporation’s safety and risk management concepts. Collaboration in launching these programs between different departments in subsidiaries can bring satisfactory effects. In German coal mining companies, risk management integrates occupational safety and health and environmental protection and is developed from the concept of the corporation. All programs and measures are supported by different divisions and other departments of the corporation, and are supervised by the corporation committee.

![Diagram of RAG model in OSH management with goal setting](Adapted from D. Mantwill, 2007)

The Vietnamese coal mining companies can organize their management by applying this model. There should be more integration and collaboration among technical departments (for example: mining design, excavation, mine blasting, ventilation, water drainage, survey measures, safety management etc.), and the Labor Union and Youth Union. Safety standards, other guidelines, training recruitment, and application of lean management etc. are organized by technical departments. However, the success of these activities cannot be fulfilled without the support of
other division such as the Labor Union and Youth Union, the two organizations that most of the staff join.\(^{379}\)

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**Figure 4.6** Model of OSH and risk management measures at the subsidiaries level in Vinacomin

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4.5 **Transference at the management department and production unit level**

The transference of the risk management system in German coal mining companies to coal companies in Vietnam should be conducted through safety training programs. The reforms of the safety training programs are in terms of structure, content and training methods.\(^{380}\)

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\(^{379}\) Personnel and Earnings Department, Vietnam National Coal, Minerals Industries Holding Corporation Limited (2011)  
\(^{380}\) N. Nguyen (2011a)
4.5.1 Aims of (pilot) safety training programs

As learners are more receptive following a major incident, the real challenge is to get people to learn and change before an incident occurs\(^\text{381}\). Safety training program, therefore, become significant for employees. Within the framework of transference, some safety seminars have been organized for managers and workers at some coal companies in Vietnam.

The aims of safety training seminars are developing safety awareness and permanent compliance in learning, understanding and implementation\(^\text{382-384}\). Through training seminars, trainees can (1) know (the theory), then (2) understand (the specific application). Moreover, workers can (3) accept (the safe way of working as adding value) and finally (4) perform effectively and safely\(^\text{385}\) at their workplaces.

Consequently, the roles of trainers in safety training programs have to be redefines. In most Asian Confucian cultures\(^\text{386}\), Confucianism\(^\text{387, 388}\) created a stable and important role of the teacher/lecturer who is respected\(^\text{389}\) in education and

\(^{381}\) K. Myers (2012)
\(^{382}\) M. Fülleman (2011)
\(^{383}\) N. Nguyen (2011a)
\(^{384}\) N. Nguyen (2011b), Discussion about motivation in risk management in Vietnamese coal mining industry, Mining industry journal, Vol 5 2011, p. 54 – 56 (Vietnamese)
\(^{385}\) M. Fülleman (2011)

Confucius (551-479 BCE), according to the Chinese tradition, was a thinker, political figure, educator, and founder of the Ru School of Chinese thought. His teachings, preserved in the Lunyu or Analects, form the foundation of much of the subsequent Chinese speculation on the education and comportment of the ideal man, how such an individual should live his life and interact with others, and the forms of society and government in which he should participate. Fung Yu-lan, one of the great 20th century authorities in the history of Chinese thought, compares Confucius’ influence in Chinese history with that of Socrates in the West.


The concept of Confucius became then Confucian tradition, namely, the Way (Dao), ritual/propriety (Li), humaneness (Ren) and virtue (De) (p.26), became a specific term for those who followed Confucius to interpret, and teach, the classics, and who engaged themselves in administration, education and the preservation of ancient rituals (p.27).

Chinese culture, and to some extent, East Asian culture, would be forever linked with Confucianism (p.17)

\(^{389}\) T.H.N Pham (2011)
In participatory training methods, teachers/lecturers/trainers should develop their roles from teacher, to coach, then to motivator, and mentor.

Figure 4.7 The four steps to behavior change (Adapted from M. Füllemann, 2011)

Safety training seminars were held by the author for 36 participants from different departments of collieries such as staff of technical departments (Vang Danh, Ha Lam, 86), heads of safety departments and other staff (Vang Danh, Ha Lam, 86), safety surveillance (86), (assistant) foremen (Vang Danh, Ha Lam, 86), trainers (Vang Danh), engineers from ventilation/drainage departments and electro-mechanic departments, human resource managers, and Labor Union staff (Vang Danh). Senior managers such as a vice/director and the Safety Executive in Vang Danh Coal Company also participated in the seminar. The work experience in the companies of participants ranks from 2 to 40 years. The author played the role of a motivator and a mentor in these seminars. By participatory training methods, participants actively contributed their ideas and shared their experiences. New knowledge in risk management was applied to case studies. Through these pilot seminars, requisites for a successful transference of risk management system from Germany to underground coal mines in Vietnam became apparent to the author.

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390 An old oriental saying in Vietnam: Whoever teaches us a single letter is our teacher, even half of a letter is also our teacher.
391 Another old oriental saying in Vietnam: First one needs to acquire the rule of rituals and propriety before achieving any other knowledge.
392 M. Füllemann (2011)
4.5.2 Content of safety training programs

4.5.2.1 Modules of safety training

The safety training programs were conducted in two parts with 3 hours for each part (15 minutes for a coffee break in each part and one hour for lunch were not included).

Theoretical sessions referred to how to deal with risks (planning), implementation of risk management at different management levels, and improvement of the risk management system, etc. In the pilot safety training seminars, regulations and guidelines of safety at work (from the Labor Code, Ministry of Labor, Invalid and Social Affairs, Vinacomin and companies Ha Lam, Vang Danh and 86) were not mentioned as they were all included the current safety training programs of each colliery393, 394, 395.

In practical sessions, the participants were assigned to work in groups with case studies. Then they presented the results and exchanged ideas with the other groups. This is an improvement in comparison to the current safety training programs with conventional training methods396.

4.5.2.2 Content of training seminars

In the pilot training seminars, the main content has been systematized as follows:

- Theoretical sessions:
  - Definition of risk and chance
  - The essences of risk management
  - Definition of risk and chance management
  - Risk and chance management as a system
  - Implementation of risk management as a strategic management function: Plan – Do – Check – Act
    - Plan: For the process of risk management: who are the parties ultimately involved?; What do the managers (or stakeholders) want to achieve?; What are managers (or stakeholders)

393 Ha Lam Joint Stock Coal Company, Lectures of safety training programs (internal documents) (Vietnamese)
394 Vang Danh Joint Stock Coal Company, Lectures of safety training programs (internal documents) (Vietnamese)
395 86 Coal Company, Lectures of safety training programs (internal documents) (Vietnamese)
396 86 Coal Company: Annual safety training programs – time schedule (Vietnamese)
interested in?; Which way/ how is it done?; What resources are required?; and When is it done? etc. are questioned in the planning process 397;

- Do: Implementation of the plan at different levels: offering appropriate conditions to risk management; involvement of consultants and workers 398; processing feedback from the bottom of the hierarchy to the top management 399;

- Check: Evaluation of the situation with “risk management” and “without risk management”; discussion of the disadvantages and requisites of risk management; comparison of the results of risk management with set targets, standards, norms, regulations etc., and

- Act: Improvement of risk management by know-how and knowledge transference and other financial incentives.

  - Implementation of risk management as an integral management function: Identification – Analysis – Assessment – Treatment

  - Identification: Methods to identify risks: Fault Tree Analysis (FTA), Hazard and Operability Studies (HazOps), Potential Human Error Identification (PHEI), Workplace Risk Assessment and Control (WRAC), What-if? Analysis etc. 400; or other methods such as survey analysis, document analysis, organization analysis, interviewing employees, by workshops, check-lists, and observation etc. 401;

  - Analysis: The likelihood of risks occurring and the consequences of damages from risks. Both likelihood and consequences can be defined by qualitative and quantitative norms;

  - Assessment: The risk matrix and its usage: a risk list and the matrix illustrated by different areas of major risks (red symbols), medium risks (yellow symbols) and minor risks (green symbols) 402, 403; and

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398 M. Füllemann (2011)
399 J. Kretschmann, N. Nguyen (2011b)
400 Australian Department of mineral resources (1997)
401 RAG (2011), p.10
402 Bergbau- und Steinbruchs- Berufsgenossenschaft (2009), Anleitung zur Gefährdungsbeurteilung, p. 8 - 15
403 J. Kretschmann, N. Nguyen (2011c)
- **Treatment of risk**: Measurement to deal with risk: technical and organizational measurement, people’s behavior adjustment (TOP measurement)\textsuperscript{404} regarding avoidance, reduction, rolling over or acceptance (self-bearing) risks \textsuperscript{405, 406}.

- Practical sessions: Participants worked in groups. The implementation of risk management was conducted both in strategic and executive functions. After spending about 2 hours allocating resources (time, equipment, tools, tasks etc.) and taking part in discussions, participants presented their results in terms of identification, analysis, assessment and treatment of risks. They also discussed with their colleagues in other groups to clarify each task or to gain more experience.

### 4.5.3 Methods of training

In conventional training, the trainer defines what is to be taught and the method to be used\textsuperscript{407}. This approach of training is based on the idea that trainer knows everything, while the learner knows nothing. The trainer defines the particular set of what learners need to learn and how these learning needs can be met. Learners do not have any other role during this process. In conventional training, the trainer becomes the central point around whom the entire process revolves\textsuperscript{408}. The trainer-centered approach, thus, does not match the aims of the pilot safety training seminars.

Participatory training methods promote learner-centered development through training and learning. The training should be multi-sectoral, participatory, interactive and focused on group work, listening and observation skills, and practice problem-solving. Participatory training is learner-centered as it recognizes, evaluates and seeks to build on the existing knowledge of trainees. By validating people’s actual experiences, participatory training enables them to formulate joint strategies for, and a commitment to, changing their immediate situation\textsuperscript{409}. In pilot safety training seminars in Vietnam, participatory training methods helped learners by enabling

\textsuperscript{404} Bergbau- und Steinbruchs- Berufsgenossenschaft (2009), p.6
\textsuperscript{405} Romeike (2002)
\textsuperscript{406} Australian Department of mineral resources (1997)
\textsuperscript{407} PRIA (2002), Participatory training: a book of readings, PRIA
\textsuperscript{408} PRIA (2002), p. 15
\textsuperscript{409} German Foundation for International Development (Deutsche Stiftung für Internationale Entwicklung – DSE), Participatory training for development – training of trainers, Out of Africa Publishers
individuals to develop skills, knowledge and attitudes, and to share lessons learnt so that they can actively contribute to renewal and improvement.  

In the training rooms, the seats were arranged in a U form for better contact with other people and the trainer, and the following tools and materials were used:

- Board;
- Moderating box and contents;
- Sheets of A0 paper;
- Notebooks;
- Laptop;
- Slides;
- Projector and screen.

The moderator box and its belongings were used for implementation of mesocard (moderation method) and ZOPP, which have been popularly used in Germany and in training courses in RAG.

Figure 4.8   Facilities in the training seminar room – Ha Lam Joint Stock Coal Company

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410 N. Nguyen (2011a)  
412 J. Meyer – Stamer (2005), How to conduct a PACA Exercise (PACA: Participatory Appraisal of Competitive Advantage), Mesopartner local economic delivery, Version 5.1  
413 Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (1997), Zielorientierte Project Planung - ZOPP: Goal-oriented project planning is the instrument of GTZ for planning and qualified developed in GTZ over a long period.  
414 Author’s note: Participatory training methods are used in the training courses of the RAG training center, for instance in safety courses named “Ausbildung zur Sonstige Sicherheitsfachkraft nach BVOASi” (Training for safety experts after mining ordinance of safety at work) and “Grundlagen für die Tätigkeit des Sicherheitsbeauftragten” (Basis for activities of safety officer).
The subsequent participatory training methods were used in the pilot safety training seminars in Vietnam:

- **Mesocard**\(^{415}\): a method to communicate by writing on cards and sticking them to the wall instead of just talking. This is very productive in conducting brainstorming and planning processes in a group. The basic format consists of a card with a question being taped or pinned to a place which is visible to all participants, and all participants responding by writing the answer/comment/proposal on the cards, all of which are then read aloud and pinned or taped to the wall\(^ {416}\):
  
  o **Rule:** Three basic rules:
    - Write legibly;
    - Aim at 7 – 10 words / 3 – 4 lines per card; and
    - Only 1 idea/ observation/suggestion per card;
  
  o **Advantages:** each member of the group can participate. More people can communicate at the same time. The communication is visible, it is traceable, and it is goal-oriented. The process is participatory. It also offers some degrees of anonymity;
  
  o **Disadvantages:** some people are not comfortable with the method, for instance because they are afraid that it might become embarrassing, or just because it is participatory. It is sometimes tricky to apply in settings where the local culture gives a very strong emphasis on hierarchy, and where communication between people from different hierarchical levels is not common;
  
  o **Limitations:** mesocard is usually more efficient than oral communication. However, there is usually a time limit of one hour to run a useful mesocard exercise\(^ {417}\).

- **Goal-oriented project planning:** The approach provides a systematic structure for planning, setting targets, analysis, allocation of human resources of projects (of tasks, in seminars) in a workshop, with principal target groups\(^ {418}\);

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\(^{415}\) J. Meyer – Stamer (2005): mesocard is also known as Metaplan, which is a trademark owned by the company of the same name, using cardboard cards, of between 8 × 16 and 10 × 20cm in size (normally in A6), markers, adhesive tape, and craft paper sized about 90 × 120cm. In the de luxe version, the cards are pinned to moveable panels rather than taped onto the craft paper.

\(^{416}\) J. Meyer – Stamer (2005), p. 103

\(^{417}\) J. Meyer – Stamer (2005): If verbal discussions come up, nobody should talk for more than 30 seconds at a time, and everyone should try to write her/his arguments on the cards so that they are not forgotten. Cards which do not fit into the current question may be put, visibly, in a different section for possible use later. If observations are contested, the counter – argument should be written on a card, and argument and counter-argument should be marked with a flash, p. 105

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Discussion method: a strategy for achieving instructional objectives that involves a group of people, usually in the roles of moderator and participant, who communicate with each other using verbal, nonverbal, and listening processes\(^{419}\). The discussion method requires the teacher and students to organize themselves into a group, which has been defined as “a collection of interacting persons with some degree of reciprocal influence over one another”\(^{420}\):

- Advantages:
  - Learners’ activity can be high; and
  - Interest can be quickly aroused;

- Disadvantages:
  - Time-consuming to obtain anything worthwhile;
  - Has to be extremely well controlled to be of value; and
  - To run well, learners must know or have opinions about the topic\(^{421}\);

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\(^{418}\) Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (1997)


\(^{421}\) United Nations Office on Drugs and Crime, Regional Office for South Asia, *Guide for trainers, a manual on techniques of training*, p. 26
Figure 4.10 Discussion in safety training seminars in 86 Coal Company (left) and in Ha Lam Joint Stock Coal Company

- Case study method: In the case study method, other’s experiences are provided to the group in the form of a case. These experiences are reflected upon and analyzed by the learners to derive new principles. The learner’s own experiences, values, and feelings form the basis for analysis of other’s experiences:

Figure 4.11 Case study practice using a risk map in 86 Coal Company

- Advantages:
  - Simple;
  - Can be used with illiterates and relatively unsophisticated people;
  - Can be used for cognitive learning; and
- Culturally appropriate;
  - Disadvantages:
    - May be difficult to find an appropriate case study; and
    - The case study may be too general to focus on a specific issue\textsuperscript{422}.

\textbf{4.5.4 Seminar procedure and the role of the trainer}

The seminar procedure was organized into the following sessions:

- Opening and Motivation sessions: (90 minutes): Participants used mesocard and postcards to introduce themselves (names, job titles and duties, experience at work, etc.) and their expectations of the seminar;
- Coffee break (15 minutes);
- Theoretical inputs: (90 minutes): Risk management and occupational safety and health – Concept and implementation
- Lunch break (1 hour);
- Practical part: Discussion (90 minutes): Trainees formed their own groups of fewer than 6 people and implemented risk management in their own workplaces/ production units/ departments;
- Coffee break (15 minutes);
- Practical part: Presentation (60 minutes): Each group presented their results and shared their experiences and ideas with the other groups in 15 minute slots; and
- Feedback and Evaluation (30 minutes).

Before the theoretical session, participants were asked to introduce themselves, sharing briefly their experiences and expectations of the content of the seminar. From this session, they overcame their hesitancy of talking, they wanted to share their own experiences with others, and were more open to joining in with the seminars\textsuperscript{423}. In this session, the trainer facilitated the seminars by creating a friendly and cooperative atmosphere, and building trust from the participants (as guided in mesocard\textsuperscript{424}).

\textsuperscript{422} PRIA (2002), p. 67
\textsuperscript{423} N. Nguyen (2011a)
\textsuperscript{424} J. Meyer – Stammer (2005), 12 Mesocard exercise principles, p. 104
(1) Facilitate: don’t preach, don’t teach; (2) Facilitate. Don’t speculate; (3) Facilitate. Don’t offend; (4) Accept different learning and thinking speeds of participants; (5) Always ask a complete question;
Therefore, participants had the motivation to contribute to the seminar and comply with the guidelines.

Figure 4.12  Introduction and motivation session in seminar in Vang Danh Joint Stock Coal Company

In the theoretical inputs sessions, participants were willing to share their ideas and experiences. When learners got used to speaking out loud, they were very excited to contribute more in the practical part. The trainer played the role of a teacher when they provided new knowledge and techniques (but not the central role as was usual in Vietnam). The other role is being a coach to help participants to understand this knowledge and these techniques by all their contributions and question exchanges.

The practical sessions included two parts, namely, discussion and presentation, through which knowledge and techniques were all consolidated. Participants were equal in their contributions to the achievement of the groups. The trainer played the role of a motivator and a mentor when facilitating and supporting participants’ development.

(6) Always ask open-ended questions; (7) Be careful when you give examples; (8) Don’t be too neat when putting up the cards; (9) Don’t order the cards when putting them up; (10) Never give the impression that you are hiding the cards or letting them disappear; (11) Be visible; and (12) Be a good example.

425 N. Nguyen (2011a)
426 N. Nguyen (2011a)
427 S. Koki (1997), The role of teacher mentoring in educational reform, Pacific resources for education and learning

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Figure 4.13  Theoretical inputs in Ha Lam Joint Stock Coal Company

Figure 4.14  Discussion in a practical session
Ha Lam Joint Stock Coal Company

Figure 4.15  Presentation with an implementation of risk map
86 Coal Company
Finally, participants evaluated the seminars with comments and remarks, and shared their suggestions for improvement of their specific jobs and duties. By speaking out loud in front of others, it was as if they were making promises to the audience\textsuperscript{428}. However, it takes time and reminding for participants to remember what they had said and to motivate them to implement these improvements\textsuperscript{429}.

Feedback and evaluation of the seminars are useful afterwards, as the students can reflect on the motivation and implementation during the training, regarding both the content and the structure. From the feedback, the students can be aware of what they should do better and find solutions to deal with difficulties. Communication, cooperation, and capacity for teamwork are also stimulated\textsuperscript{430}.

Evaluation means the systematic eliciting and analysis of feedback information about the relevance and impact of the training in order to assess whether learning or change has been effectively brought about\textsuperscript{431}. In the pilot safety training seminars, participants compared what they had learnt with their expectations and briefly assessed their satisfaction of the seminar etc. Participants evaluated the seminars by verbally sharing, one by one, as they can change their attitude from hesitancy to open-mindedness\textsuperscript{432}.

The participants were excited after the motivation sessions\textsuperscript{433}, interested in the theoretical input\textsuperscript{434}, involved in the discussion and case studies\textsuperscript{435}, and almost satisfied with all aspects the seminars (in descending order): (1), time schedule (36/36 participants), atmosphere (36/36), and theoretical inputs (35/36); (2)

\textsuperscript{428} N. Nguyen (2011a)  
\textsuperscript{429} J. Kretschmann, N. Nguyen (2012a)  
\textsuperscript{431} PRIA (2002), p.91  
\textsuperscript{432} N. Nguyen (2011a)  
\textsuperscript{433} Author’s note: From the feedback of a participant in 86 Coal Company, it was the first time he had a chance to join a training seminar where he was allowed to eat and drink during the studying. Those made him think he could raise questions and exchange ideas without any hesitance.  
\textsuperscript{434} Author’s note: in Vang Danh Joint Stock Coal Company the theoretical input lasted longer than planned as the Safety Executive wanted to contribute more in the theoretical input.  
\textsuperscript{435} Author’s note: 34/36 participants contributed their opinions in the discussion; the others hardly spoke during the entire seminar.
motivation (34/36) and practical part of discussion and case studies (34/36); (3) presentation (33/36). Participants also gave also valuable feedback and follow-up\textsuperscript{436}.

The role of the trainer in this part was also as a mentor.

![Figure 4.16](image)

**Figure 4.16 Feedback and evaluation session in 86 Coal Company**

4.5.5 Seminar outcomes

It would be incomplete if the outcomes were assessed only a short time after the seminars’ completion. Six months after the seminars, another survey was conducted with managers of the three companies.

The seminars evaluation session is like the reflection of the participant. Participants expressed their own opinions towards the safety training seminars as follows\textsuperscript{437}:

- As most of the participants had never had experiences of similar seminars, they were totally impressed and persuaded by the effectiveness of the structure and participatory training methods;

\textsuperscript{436} Author’s note: (1) Some valuable feedback from Vang Danh Joint Stock Coal Company: “I harvested more than I had sown in the seminar (I got more than I had contributed)”; “I could gain a lot of new knowledge and new skills in teaching, that I could apply in my following lectures as a trainer of safety programs”, etc.; (2) Some follow-ups: positive, in Ha Lam Joint Stock Coal Company (6 months after the training): A foreman remembers asking himself “what else” every time he delivers the duties for his workers at the beginning of a shift, to “double check” to assure safety; negative: in 86 Coal Company: the trainer had also reminded the participants – most of them are surveillance – that ignorance of risks and subjective thoughts could create damage. However, a fatal accident still happened after that (July 2012): CH\textsubscript{4} density was measured higher than the standards, but they still let the workers go underground, as there was allowance for several times without any fatalities. The accident was caused by sparks from electronic equipment, 4 killed.

\textsuperscript{437} N. Nguyen (2011a)
- Consequently, participants gradually became involved in the theoretical input by sharing their experiences from the reality of production, and giving clear and focused answers with appropriate explanations and clear arguments;

- The inherent hesitancy in speaking, discussing with higher level managers and presenting in front of a group (of strange people) steadily faded;

- Teamwork guidelines were quickly understood by participants, their teamwork skills were simultaneously implemented during seminars;

- 15-minutes breaks were reasonable, as the participants did not feel stressed but looked forward to the upcoming sessions;

- When participants’ ideas were listened to, they thought that they were being treated equally and respected. This made them eager to contribute more intensively for the improvement of the training programs (not only for their sakes but also for other colleagues’);

- After the seminars, the participants were intrinsically eager to improve their performance in the workplace and to share what they had learnt in the seminars with other colleagues; and

- Practical sessions and rehearsals in fact helped them to better understand the theoretical input, and then they could form their set of safety skills at work.

One of the advantages of the pilot program was that safety managers (a Safety Executive and head of the safety departments) participated in the whole seminar. Though their participation, they became aware of the main problems that their workers were facing, and how workers can improve the situation if they were appropriately motivated: by financial incentives438, and by the serious consideration of their feedback and contributions.

From the expectation/motivation session, the trainer can adjust some of the content of the theoretical input and practical sections that match the needs of the audience. Receiving feedback and evaluation helped the trainer improve the content and structure or have better communication with the participants in the upcoming seminars, etc. Some requisites for the successful implementation of German safety training programs could be understood.

438 Author’s note: In Ha Lam Joint Stock Coal Company, as the seminar was held on Saturday, participants were paid (by the company) 150% of their daily wages.
4.5.6 Improvement in seminars for more effective transference

There should be some improvement in the seminars for increase in effectiveness, such as:

- Time frame of the seminars;
- Structure and content of the seminars;
- Methods of training;
- Modules of training and materials;
- Measures of evaluation;
- Trainers’ capacity; and
- Technical, financial and organizational support from the beneficiaries of seminars: companies and the corporation (Vinacomin); from other international corporations and organizations (German Hard Coal companies, ISSA Mining, MoLISA Vietnam, ASEAN – OSHNET, etc.)

It would be better if the seminars could be extended from one day to one and a half or two days. Participants would have more time to integrate and contribute to theoretical input and practical parts. In the evaluation, not only verbal sharing but the questionnaires should be used for fully-constituted assessment. Field trips can be held for better understanding of practical procedures in risk management. During the field trips, participants can find small things that should be adjusted or changed in work places. Effects of the seminars on the participants could thus be better and last longer.

Were the time frame to be extended, the seminars could be organized as follows: (1) motivation session; (2) theoretical and practical session 1; (3) theoretical and practical session 2; and (4) feedback and evaluation. The two sessions (2) and (3) can be conducted with different content through modules of training. Accordingly, other participatory training methods could also be implemented.

Regarding participatory training methods, learning games, role-play, field trips, and simulation are good suggestions. Participants can exchange experiences, share

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439 J. Kretschmann, N. Nguyen (2012a)
reactions and observations, reflect upon implications and consequences, and discuss patterns and dynamics through these methods. Subsequently, they can develop practical and conceptual understanding. Choosing appropriate participatory training methods is significant for the enhancement of seminars’ effectiveness:

- If the focus of the training is increasing knowledge then the most appropriate methods used are lectures, field visits, demonstrations, self-study, etc;
- If the focus of the training is increasing skills, practical orientated methods like apprenticeship and learning by doing (hands-on) are favorable;
- If the focus of learning is generating awareness then the methods used are role-play, discussion in groups, case studies, simulation, learning games, exercises, etc.

Regarding training materials, trainers in Vinacomin should use visual materials such as photos of accidents and victims, unsafe behavior, and video clips to introduce safety standards. This could help the participants to remember the information, better than just listening to the trainers, or reading documents or books. Additionally, posters could also be used for better effect. The use of related statistical data and charts could also bring other advantages.

The theoretical input sessions should be systematic, scientific, updated, and realistic. The systemization of knowledge and techniques helps participants better obtain new knowledge and skills. The scientific features illustrated by up-to-date achievements of the German risk management system become persuasive evidence to the transferees. The linking of these achievements with the Vietnamese coal industry’s state-of-the-art in risk management is also important for the feasibility of the transference.

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441 PRIA (2002)
442 PRIA (2002), p.62
443 J. Kretschmann (2000)
444 N. Nguyen (2012)
445 N. Nguyen (2012)
Practical sessions can be improved by the anticipation of risks, as participants can accumulate experiences from others. In discussions, trainers should use both yes/no questions and WHs questions to help participants in finding appropriate solutions or scenarios. Yes/no questions cannot give more than one choice but by using other types of question strong arguments can be offered (by the trainer and/or participants). Presentations in a group (not by a unique representative) are good choice for improving communication skills of workers with other colleagues and managers.

Checklists, questionnaires, and large group discussions can be used in feedback and evaluation for better results post-training. The impact of training, attitudinal and behavioral changes and the follow-up can be recognized and analyzed in meetings or workshops.

Retraining is an indispensable component of training programs in RAG that brings the exchange of experiences, updated information, the addition of new knowledge and further improvement. Therefore, the training programs for safety surveillance forces in Vietnam can be organized with a basic training course and annual retraining.

The transference of the risk management system from the German hard coal mining industry cannot be successful without qualified trainers. The training program needs to be expanded and developed to “train-the-trainer” programs, providing both technical and didactic knowledge and skills for Vinacomin’s trainers.

However, without technical, financial and organizational support from subsidiaries of Vinacomin, German Hard Coal Corporation, BG RCI, ISSA Mining, MoLISA Vietnam, ASEAN – OSHNET, etc., the above target can hardly be achieved.

Support from RAG comes from updated information in risk management, and example safety training programs for particular participants. “Sandwich” train-the-
trainer programs (half the time in Vietnam, half the time in Germany) could secure the success of the programs.

As prevention is one of the most important tasks of the BG RCI\textsuperscript{451}, there are various publications of this organization such as CDs (containing handbooks, introductions for practical aids, occupational safety and health practical guidelines etc.), magazines, posters, etc. These materials can provide sufficient theoretical inputs for safety training seminars.

The transference could be more widely feasible when there are collaborations from MoLISA Vietnam, ISSA Mining and ASEAN – OSHNET with strong commitment to Southeast Asian countries. Safety competence can be enhanced through regular safety training and risk management conferences in ASEAN\textsuperscript{452}. It is one of the necessities for knowledge and information exchange in the higher levels of management in companies and corporations as well as national authorities.

\begin{footnotesize}
\textsuperscript{451} Official website of the Berufsgenossenschaft Rohstoffe und Chemische Industrie http://www.bgri.de/ (access in September 2012)
\textsuperscript{452} J. Kretschmann, N. Nguyen (2012a)
\end{footnotesize}
5 Results of the transference and other requisites

5.1 Results of the transference in Vinacomin

The transference can be considered an integral measure in improvement of risk management towards Vinacomin. Thus, its results for Vinacomin are qualitatively measured.

Firstly, regarding technical risks and occupational safety and health, the knowledge of risk management and safety competence of managers and other staff have been developed. As two directions of risk management are transferred – top-down and bottom-up – the transference can reach all management levels in Vinacomin.

Figure 5.1 Strategic international conference in frame of the National Week on Occupational Safety and Health – Prevention of Fires Explosion

MoLISA Vietnam, in collaboration with ILO, ASEAN-OSHNET, ISSA Mining (and in 2012, with IALI), holds annually the National Week on Occupational Safety and Health and Prevention of Fires Explosion (OSH-PFE) with strategic and national safety programs of all companies453,454. An international strategic conference is

454 Official website of ISSA Mining: http://www.issa.int/About-ISSA/Prevention-Sections/Section-on-Prevention-in-the-Mining-Industry/Announcements/Successful-cooperation-tied-ISSA-Mining-co-hosts-workshop-extends-cooperation-agreement/(language)/eng-GB (September 2012)
organized in the National Week, including updated information and lessons learnt from German risk management. The active participation of Vinacomin in these strategic activities helps to increase safety competence and to gain experience from Germany and other countries.

Effective risk management and better safety competence in companies also brings other advantages. For example, with the low fatalities 2011 in Vinacomin, the corporation could eliminate costs in the short-term, such as compensation for fatalities (including paying for dead people, and raising their children who are under 18 years old, as regulated), costs for rescuing and burial, costs for accidental inspection and fines, fixed costs of decreased production etc. In the long-term, they can try to improve the effect on safety management, and prevent almost all potential incidents and accidents. Therefore, prevention cost can also be eliminated gradually.

Moreover, as stated by Heinrich’s Law, if (fatal) accidents are reduced, other major and minor accidents will also be reduced. This helps to improve the image of the corporation in society and with the authorities, and the labor force’s satisfaction and motivation at work. The better the accidents control, the more advantages the corporation and each individual company can gain. A better image of safety management helps to attract newcomers to join the mining industry, and to solve the challenge of the labor-force shortage for underground mines in upcoming years. Without this the ambitious planned development program of Vinacomin will not be realistic.

Secondly, the transference introduced new training methods for trainers in different mines. In principle, these participatory training methods can be implemented in

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455 Author’s note: From 2010 to 2012 the author took part in that kind of conference with two co-presentations in 2010 (Transferring the risk management system of a German mining company to South East Asia) and 2011 (Risk map and the application for risk management in solid minerals and stone excavation in Vietnam).

456 Author’s note: In 2010: 10/19 presentations were from German participants who work in fields of mining or occupational safety and health. Correlative numbers were 5/17 in 2011 and 7/14 in 2012.


458 N. Nguyen, J. Kretschmann (2012b)

459 E. Hollnagel (2009)

460 N. Nguyen, J. Kretschmann (2012b)
different kinds of training in all of subsidiaries of Vinacomin and for various contents. After the pilot safety training seminars in Ha Lam Joint Stock Coal Company, Vang Danh Joint Stock Coal Company and 86 Coal Company with positive evaluation from the participants, the seminars’ structure and training methods were suggested for further application in a project of the Ministry of Industry and Trade in 2012. In the sub-theme named “Suggestion for support mechanism and policy in education and training for improvement of management competence, special skills, and workmanship of staff in mining companies”461, the transference and the participatory training methods were also mentioned.

Thirdly, this might be considered the first transference of a risk management system to Vinacomin. As analyzed in part 3, measures implemented in risk management were separately applied in mines as pilot projects (using chip cards and attendance readers at the mine ports, gas monitoring systems, field trips for miners’ wives, etc.), or applied in all mines but for different groups (training programs and shows of methane gas explosion for workers in underground mines, internal safety contest, etc.). “High class seminars” for the top management are recommended for better understanding of risks prevention. For example, in these seminars, a persuasive evidence of the return of prevention (ROP) can be offered. This is an indicator that compares the differences between the monetary benefits and the cost of prevention. And the mean benefit-cost ratio (ROP) was 2.2. That means for every €1 (or in any other currency) per employee per year invested by companies in workplace prevention, companies can expect a potential economic return of €2.20 (or in any other currency)462. From the seminars, the financial engagement of Vinacomin can improve the transference’s effect in the future.

Furthermore, regarding the specific “First Chance Prevention” feature of the German risk management system (as mentioned in part 2), prevention was heavily mentioned during the transference. Investment for prevention, therefore, gives some advantages for Vinacomin on the side of both of the employers and workers.

461 Ministry of Industry and Trade (2012), Project: Technological renovation and modernization in mining industry to 2015, outlook to 2025, subject: Research on current situation and suggestion for the improvement of effectiveness in state authorities of the Vietnamese mining industry
For employers, investment in prevention is not only a legal and moral obligation but it also makes economic sense and is good for the corporate image: the increased health and productivity of workers are strategic assets for the increased competitiveness of companies in local and global markets.

For workers, the investment in prevention measures has led to a significant decrease in recorded accidents, including workplace fatalities and occupational disease. Improved health and employability help to secure stable income and the individual living conditions\textsuperscript{463}.

Last but not least, a good prevention program helps companies to minimize occupational accidents and incidents’ damages.

Of course, an effective risk management system requires investment in human resources, tools and other expenditures. Prevention costs are paid in the short-term, but it is obvious to see their profits for companies in the long-term.

More than 60\% of the benefits from prevention for companies, as cited in research from the International Social Security Association (ISSA)\textsuperscript{464}, came from cost savings through prevention of disruptions, added value generated by increased employee motivation and satisfaction, and added value generated by a better corporate image. These factors have a close relation to issues such as cost management, human resource and personnel management, corporate culture and companies’ images. Modern understanding of investments in prevention assures both health of the workers and profits of companies, maintaining continuous production. Thus, the prevention brings competitive advantages for companies and for the industry itself\textsuperscript{465}, according to M. E. Porter\textsuperscript{466}.

\section*{5.2 Requisites of the transference}

As mentioned in Figure 2.6, there are some factors that impact systems in companies, which are: (1) economic; (2) socio-cultural; and (3) historical/political aspects. How

\begin{thebibliography}{9}
\footnotesize
\bibitem{463} N. Nguyen, J. Kretschmann (2012b)
\bibitem{464} International Social Security Association (2012), \textit{Final report:Calculating the International Return on Prevention for companies: costs and benefits of investments in occupational safety and health.}
\bibitem{465} N. Nguyen, J. Kretschmann (2012b)
\end{thebibliography}

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these factors influence risk management systems, and thus become requisites of the risk management system’s application to Southeast Asia (with the case study of Vietnam) should be taken into consideration. The two main requisites which will be discussed hereafter are economic and cultural factors. Historical and political factors could be considered as environment during the analysis. It is because in the context of the historical, other changes in all politic, economic and socio-cultural aspects have mutual impacts\textsuperscript{467}.

5.2.1 Economic requisites

One of the main requisites to improve risk management at the company level is the traditional view: investments in prevention are externally imposed costs\textsuperscript{468}. In the economic downturn in Southeast Asia\textsuperscript{469}, there would be some challenges for workplace prevention of which the International Labor Organization (ILO) as well as the ISSA have warned. Some main points of these warnings could also be emphasized to Vinacomin, as they are disadvantages in the mining industry:

- Reduction in the use of internal and external OSH specialists in companies;
- Reduction in the use of OSH measures such as training and equipment;
- Hazards of longer working hours, heavier workloads and new job roles;
- Higher levels of psychosocial stress attributable to job insecurity; and
- Higher risk of accidents caused by longer working hours and higher working intensity\textsuperscript{470,471}.

ILO has been making an effort to show consequences from the financial crisis (and thus economic recession) to nations and countries in Figure 5.4\textsuperscript{472}.

\textsuperscript{467} Der Archivar (2011), Gespräch mit Hanns Jürgen Küsters zum Verhältnis von Archiven und Historischer Forschung, Vol. 4 Nov 2011, p. 396
\textsuperscript{468} N. Nguyen, J. Kretschmann (2012b)
\textsuperscript{469} United Nations (2012), World economic situation and prospects, p. 117

East Asia’s strong growth momentum slowed in 2011, particularly in the second half of the year, as the region felt the impact of increased global uncertainty and weaker demand in developed economies. The region’s GDP is estimated to have expanded by 7.2 per cent in 2011, down from 9.2 per cent in 2010. With exports projected to slow further in the coming quarters, average growth is forecast to decline to 6.9 per cent in 2012 and 2013.

\textsuperscript{470} International Labor Organization – ILO (2009), Health and life at work: a basic human right, World Day for safety and health at work, Geneva
\textsuperscript{471} International Social Security Association – ISSA (2010), The impact of crisis on the mental health of workers, Geneva
\textsuperscript{472} International Labor Organization – ILO (2009)
When the financial crisis first struck in 2007, it was pointed out that the crisis would create a more stressful environment and this would have an impact on the mental health of workers. High inflation, especially in food prices, is a psychosocial issue for workers, as people have physiological basic needs for food and drink before other needs. This is also a motivation for workers looking for higher salary by working harder and even passing over working procedures and safety standards.

In Vietnam, due to the negative impact of the financial and economic crisis, coal production of Vinacomin is gradually reduced by the degradation of exports. As

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476 Vietnam National Coal, Minerals Industries Holding Corporation Limited (2012d), Report of production in 7 months, implementation predictions to the end of 2012, planning and solutions for 2013 (Vietnamese)
Coal export in July 2012 reached 300,000 tons, ranked the lowest in 10 years.
domestic coal prices in Vietnam are controlled by the government\textsuperscript{477}, domestic revenue has also decreased\textsuperscript{478}. In 2012, there were several mines where workers worked less than 26 days each month\textsuperscript{479} (regulated working days by the Labor Code\textsuperscript{480}). The reduction of staff and workers’ income\textsuperscript{481} became an obstacle for their motivation of implementation risk management measures, as they have already been put under physical and mental stress from tough lives\textsuperscript{482,483}. As a result, the number of fatal accidents in 2012 increased again (Figure 3.11).

The implementation of modern training methods and curricula in Vinacomin is also a challenge that should not be ignored. If managers in Vinacomin and other subsidiaries can take the opportunities of subdued production recently to check all the procedures and require a strict obedience to safety regulations and risk management procedure, they could determine that improvement of risk management in the entire corporation is necessary. The implementation also depends on the priorities and the business culture of Vinacomin.

\textsuperscript{477} Notice of the Government Bureau No 244, dated 11/8/2009 (Vietnamese)
\textsuperscript{478} Vietnam National Coal, Minerals Industries Holding Corporation Limited (2012d)
\textsuperscript{479} To July 2012, sales of coal reached 21.8 million tons, equal to 48\% of the prediction and 88\% of the same period in 2011.
\textsuperscript{480} Social Republic of Vietnam, the Labor Code was first issued in 23/6/1994, amended and supplemented on 24/2/2002.
\textsuperscript{481} Article 68 §1: The normal working hours shall not exceed 8 hours per day or 48 hours per week. An employer shall have the right to determine the working hours on a daily or a weekly basis provided that the employees are notified in advance.
\textsuperscript{482} Salary of all staff (except for underground workers) has been reduced 10\% to salary in 2011.
\textsuperscript{483} Author’s note: In comparison to the decreasing salary in Vinacomin, the average consumer price indexes (CPI) in 7 months of 2012 rose 11.2\% against that in the same period in 2011 (Source: Official website of the Vietnam General statistics office, available online at http://www.gso.gov.vn/default.aspx?tabid=622&ItemID=12538 – accessible in September 2012). Asian Development Bank (2012) assessed that inflation in Vietnam was still high at 14.2\% in March 2012 (p. 223)
\textsuperscript{484} J. T. Hallinan (2009), Why we make mistakes, Broadway Books, p.218

Happy people tend to be more creative problem solvers. They also make decisions more quickly, with less back-and-forth.
5.2.2 Cultural requisites

There are some aspects of culture that can be considered the main requisites in the transference of the risk management system from the German hard coal industry to Southeast Asian countries. Among those requisites, communication is a significant one.\(^{484}\)

Communication, as defined by the Oxford dictionary, is the imparting or exchanging of information by speaking, writing, or using some other medium, or is means of sending or receiving information.\(^{485}\) Technically, by communication, information is transported from a message source (sender) to a message sink (receiver).\(^{486}\) The transmission of information between the elements (people and materials) in an enterprise or between enterprises and their environment can be stored, recorded or transformed through the relationship of sender-receiver.\(^{487}\) Nevertheless, communication has a social dimension. Communication becomes important in risk

\(^{484}\) N. Nguyen, J. Kretschmann (2012a)
\(^{485}\) Available online at http://oxforddictionaries.com/definition/communication
\(^{487}\) J. Kretschmann (2000)
management, as working in groups is essential for adequate results in identification, analysis, assessment and treatment of risks, as no one knows everything and risks are possible in various fields\textsuperscript{488, 489} and thus, people should exchange ideas, make reports and maintain good communication within the company and the corporation.

Companies rely on the features of their native cultures but also build their own corporate cultures based on specific features\textsuperscript{490}.

A corporate culture is built on symbols, live models or other cultural artifacts such as language, rituals, and/or architects of its buildings. Conversations among employees are formed from their own history and anecdotes, events, abbreviation of technical terms, and myths about their managers and founders. Uniforms, helmets, working gloves and shoes are not only kinds of personal protective equipment but also signals for others to recognize and to differentiate employees in different working fields and help their communication.

Partly visible norms and values like maxims, ideologies, goals, strategies, prohibitions, etc., are normally formed from the leaders of the companies and affirmed in corporate mission statements.

The third stage of company culture includes the basic premises that the behavior of employees to “natural” impact, such as world views, human images, feelings, beliefs about interpersonal relationships such as competition for positions in career, consensus or competitive orientation, individualism or collectivism, etc.

The company culture has a behavior-controlling and coordinating effect on the company's employees. It is gradually introduced into the symbol systems, norms, values and basic assumption. Actions of employees in established and recognized patterns of thought, behavior and problem-solving are the proof of competence and performance; they are assessed by the company, and thus also bring rewards or penalties.

\textsuperscript{488} Australian Department of mineral resources (1997)
\textsuperscript{489} J. Kretschmann, N. Nguyen (2011b)
\textsuperscript{490} J. Kretschmann (2000)
New staff members usually need some time to get along with company culture and their motivation at work is increasingly influenced by company culture. The longer they work for a company, the more invisible ties they have with the company and their colleagues. These help to promote a good working environment.

Corporate culture enables the achievement of the corporation's goals. Any changes in a company’s culture will affect the existing functional system if they cannot be adapted. Current rules, behavior, attitudes, etc. then cannot be synchronized. However, if there is any change in the scale of corporation and its strategies, it may require changes in the corporate culture491.

But corporate culture shares the features of culture in general: dynamic, but engaged with tradition and able to adapt to changes in the long term. Another feature is the aggregation of internal subcultures with mutual reflection. For instance, generally, mining companies employ miners and mining technical staff from a small group of typical universities with specific groups of students. It also means colleagues know one another since their study and/or internship periods and their fellowships are maintained and developed over time. Miners and mining technical staff apply for jobs under the influence of their families and they are often proud to continue the traditional career. Therefore, they also gain experiences from their forerunners and have invisible connections with their careers. After being accepted into a company, they can be promoted to supervisors or managers (especially qualified engineers) and they participate in other activities such as celebrations, festivals, sports games, competitions, etc.

These invisible connections support miners in their team-work and solidarity, so that they understand the typical signals in communication at work to prevent the occurrence of risk. However, there is also a weakness in these kinds of connections. The close fellowship can make it difficult for miners to give each other strict comments or to reprimand their behavior if they are failing to obey safety standards492.

491 J. Kretschmann (2000)
492 N. Nguyen, J. Kretschmann (2012a)
Generally, during the transmission of information, content is the actual core (words or symbols) of the messages. The message itself bears four psychological aspects of content, self-revelation, relationship and appeal.\textsuperscript{493}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure5_6.png}
\caption{Four aspects of information in communication (Adapted from Schulz von Thun, 1981)}
\end{figure}

The content of a message is the topic that senders want to convey. It can be expressed by language and encoded (by senders) and decoded (by receivers). By context in encoding and decoding, misunderstanding can occur. This is because of the relationship between senders and receivers as well as the self-revelation of the transmitter. For senders, the encoding depends on experiences, desire, prejudice, emotion, tone of voice, gestures, body language, language skills (using accurate words and phrases, logically developing ideas) etc. For receivers, the decoding relates to some of the factors above in addition to the impact of the senders on the receivers, attraction, etc. There is also an appeal from senders to receivers in different ways, overt or covert, which influence the way in which the receivers receive the information. Other factors also impact the encoding and decoding, such as: features of information, noise etc.\textsuperscript{494} Hence, the accurate information transference from senders to receivers is ensured by non-misleading interpreting from the two sides and the control of external factors.

At the company level, communication is not only the transmittance of internal information but also of external communication. Company communication, therefore, “works” on communication strategies, policies and instruments.

\textsuperscript{493} F. Schulz von Thun (1981), Mit-einander Reden, I. Störungen und Klärungen, Allgemeine Psychology der Kommunikation, Reinbek bei Hamburg
\textsuperscript{494} O. Neuberger (1981), Mit einander arbeiten – mit einander reden! Vom Gespräch in unserer Arbeitswelt, München
Maintaining fluent communication should be adequate within (company) culture, by which human relationships and actions are always influenced\(^495\).

Internal communication in coal companies can help risk management in transmitting information from top managers to lower levels and vice versa, and among colleagues through their knowledge and experiences. To ensure the right content will reach the receivers without any misunderstanding, the content should be: (1) valuable (to be informed in time and in suitable circumstance); (2) adapted (to receivers); (3) coherent (match with the values and culture of receivers, for instance, related to their environment); (4) different (to individual receiver); (5) transparent (avoid of rumors and interpretation); (6) simple (easy for receivers to understand); (7) fast (available in time); (8) factual (sufficiently valid); and (9) impressive (for receivers)\(^496, 497\). Moreover, the contents should be in the context of risk management which remind receivers of dangers and care at work (e.g. wishing good luck before going underground by greetings or slogans hung-on-wall), or prevent risks from occurring or reduce damages from risks (double-check for work safety, brief information exchange between shifts before new shifts start, detailed guidelines, daily operating instructions, ideas and information exchange at sites etc.). Receivers should be encouraged to raise questions for clarification on issues which they do not fully understand or to have more discussion with the senders. Mutual understanding and good relationships between senders and receivers create a good atmosphere for discussions and effective encoding and decoding, and the transmission of accurate and decisive information for adequate risk management\(^498\).

External communication refers to communication outside the company, for example with the media, the government and other authorities, stakeholders, etc. External communication helps the company deal with crisis through public relation activities\(^499\).

However, information transmission is not always smooth. An influence of the accuracy of transmission is the self-revelation which depends on the senders

\(^{495}\) J. Kretschmann (2000)  
\(^{496}\) M. Fank (1996), p. 50  
\(^{497}\) C. Scholz (1997), *Strategische Organisation, Prinzipien zur Virtualisierung und Virtualisierung*, Landsberg/Lech, p. 282  
\(^{498}\) N. Nguyen, J. Kretschmann (2011a)  
\(^{499}\) D. Mantwill (2011)
themselves, and the other is the appeal of receivers\textsuperscript{500}. The self-revelation and appeal belong to human competence, which is either positively or negatively impacted by the advantages or disadvantages of culture\textsuperscript{501}.

Regarding communication, according to Stenzel (2010), managers should also understand that communication disadvantages (and other activities belong to organization and behavioral deficiencies) are generally responsible for 90\% of accidents\textsuperscript{502}, in order to find better ways of communication.

From some general characters of people in the Southeast Asia, such as hesitancy of mentioning the ego (I – myself) as a performance of politeness\textsuperscript{503}, avoidance of showing the individual and preference of the group\textsuperscript{504}, and high respect for older people and leaders, miners have the tendency to obey orders and statements when they talk face-to-face, seldom giving any individual response or initiating discussions\textsuperscript{505}. During a conversation, when receiving a statement or order from the elders or leaders, younger people and staff members usually give signals which give the speakers self-revelation that the rest of the group can understand well and are able to implement these orders. In fact, listeners might only be showing their respect\textsuperscript{506}, as they hear, understand the questions, requirements or statements, and agree with them\textsuperscript{507}. Hence, there is a misunderstanding in communication, especially when there is a lack of insight into the Confucian perception of the concept of communication\textsuperscript{508}. Ignorant feedback also eliminates the motivation of miners to exchange their ideas and effort to improve their situation at work\textsuperscript{509}. Therefore, the (pilot) safety training seminars with participatory training methods can encourage the participants – the (order) receivers to actively speak out about their ideas and to freely share their knowledge and experiences with others\textsuperscript{510}.

\textsuperscript{500} J. Kretschmann (2000)
\textsuperscript{501} N. Nguyen, J. Kretschmann (2012a)
\textsuperscript{502} M. Stenzel (2010)
\textsuperscript{503} T.H.N. Pham (2011)
\textsuperscript{504} F. Trompenaars, C. H. Turner (1998), \textit{Riding the waves of culture, Understanding diversity in global business, 2\textsuperscript{nd} edition}, Irwin Professional Publishing
\textsuperscript{505} N. Nguyen, J. Kretschmann (2012a)
\textsuperscript{506} N. Nguyen, J. Kretschmann (2012a)
\textsuperscript{507} T.H.N. Pham (2011), p.11
\textsuperscript{508} T.H.N. Pham (2011), p. 8
\textsuperscript{509} J. Kretschmann, N. Nguyen (2012a)
\textsuperscript{510} N. Nguyen, J. Kretschmann (2012a)
The preference for form over substance and achievement as well as the worry of “losing face” (not wanting to show one’s inabilities) are also prevent miners from full report and record of incidents and accidents occurrence\textsuperscript{511}. Statistical data, therefore, become less reliable and less useful. Improvements on substantive examination and transparency are indeed necessary\textsuperscript{512}.

In the Vietnamese coal mining industry, in addition to working relationships, colleagues are also neighbors to each other, as many of them either reside in the company's buildings, or in the same wards or villages. Therefore, there is also a character of general culture which impacts them all, called “village culture”\textsuperscript{513} which has the major features of building its own democracy, internal culture, life style and morals, and a self-managed and fixed hierarchy.

The impact of this “village culture” creates challenges to risk management. Results of experiment in Vietnamese coal mining companies show that new engineers working in surveillance at coal faces must cope with difficulties regarding their in contact with experienced workers (normally also the elders). It is also because in most Asian Confucian cultures, the elders are honored and respected\textsuperscript{514}. When they find potential risks at work and require workers to conform to disciplines, they might not get adequate cooperation from the workers on site, despite the requirement from the company of workers’ responsibilities\textsuperscript{515}.

Regarding the roles of teachers in motivation/safety training seminars, if they insist on playing the center role of the class/seminar room as they are used to being\textsuperscript{516}, the transference cannot be succesful. Trainers should step back from the central position to give the participants the initiative in learning, sharing and applying measures in risk management by playing the role of the coach, motivator and mentor during the training programs. However, the changes of trainers cannot be done without sufficient train-the-trainer programs.

\textsuperscript{512} J. Kretschmann, N. Nguyen (2012a)
\textsuperscript{513} Vietnam Encyclopaedia: Available online at http://dictionary.bachkhoatoanthu.gov.vn/ keyword: văn hóa làng (accessible April 2012)
\textsuperscript{514} T.H.N. Pham (2011), p.12, p. 18
\textsuperscript{515} J. Kretschmann, N. Nguyen (2012a)
\textsuperscript{516} J. Kretschmann, N. Nguyen (2012a)
6 Conclusion and further study

The contributions of the research are hereafter summarized with some major scientific points and the results of the experiments.

Part 1 began with the overview of risk management and technical risk management. The particular difference of risk management in German hard coal mining compared with other approaches is the relationship of risk and chance management. This is also one of the reasons for the choice of the “German style” in risk management, which would be transferred to the Southeast Asian countries. From the overview, the author offered a definition of risk, which can be considered all the behaviors or actions (from a subjective or objective side) that can probably threaten the sustainable development of our planet, our countries, our environment, our communities and/or our companies. Regarding mining companies, risk is an event or an action which occurs unexpectedly or unpredictably to people/companies and causes negative influence. Risk management, defined by the author, is a special function in business management [which] integrates other functions (personnel management, financial management, production management etc.), containing an aggregation of identification, protection and reduction of loss, damages and negative influences from risks. In this part, risk management was analyzed as a part of strategic management.

Part 1 also talked about technical risk management. Classification of technical risks and the main impact factors in coal mining industry were made. Based on the main impact factors, technical risk management in the Vietnamese coal mining industry should be based on the adaptation of human attitudes at their workplaces.

In part 2, the risk management process and risk management system of the German hard coal mining company RAG were explained. Theoretical and practical issues in RAG Corporation were also analyzed to see the outstanding achievements of the risk management system, especially in occupational safety and health in the last decades: the elimination of fatalities and the reduction of accidents per one million working hours, and, hence, the increase of productivity. Adequate improvements in techniques, organization and human resource management are the fundamentals of those achievements.
Since staff members can be seen as the most important resource of companies, RAG has been implementing measures that are motivating their staff in maintaining safety. The improvement of their safety awareness and self-implementation at work is a result of the combination of abilities and willingness, as well as knowledge and other motivation. Thus, education and training for better knowledge and skills, and how to motivate the staff becomes the core of the transference.

In part 3 the case study of the Vietnamese coal mining industry is described and analyzed. The main content of this chapter was the analysis of the status quo in risk management. General information and features of technology, infrastructure and labor force were described in both the advantages and disadvantages. Strategies of this Corporation and some subsidiaries in upcoming years were also summarized. According to the strategy, coal output from open-cast mines will be reduced from 23.3 million tons in 2014 to 8 million tons in 2030. Meanwhile, from underground mines, output will be accelerated from 33.5 million tons to 47 million tons in the same period. This is one of the challenges in risk management in Vinacomin in the forthcoming years, as geological in-depth excavation will become more complicated. The other challenges were also described, such as: the insufficient of laws, regulations, risk management outlines and technological norms, issues in technical equipment, in organizational and operational procedures, in safety awareness among employees – as of safety culture and insufficiently qualified employees, which also leads to the situation of the pervasive phenomenon of temporary and non-committal compliance or a preference for form over substance.

Adapted from the RAG Corporation’s risk management, transference of knowledge and building skills and motivation for the staff are chosen to improve the state-of-the-art in risk management in Vinacomin. This transference should be conducted by multi-level approach: at national level, corporate level (the whole corporation and other subsidiaries), department level and section level (production units). Improvement in education and training, both in content and methods at various levels in ministerial authorities, corporations, and educational institutes are the key elements of the transference. Furthermore, requisites of the transference from one of the most developed coal mining industries in Western Europe to garden-agriculture-
based ones in Southeast Asia are also discussed in terms of both economic and socio-cultural aspects. These are the main contents of parts 4 and 5.

Initially, the transference can show its gain in the pilot program held in different collieries of the Vietnamese coal mining industry. Moreover, across the boundary of the pilot program, usage of the training methods adopted from Germany could be widely applied under the support of the Vietnam National Coal, Minerals Industries Holding Corporation Limited (Vinacomin) in frame of the Project “Technological renovation and modernization in mining industry to 2015, outlook to 2025”, sub-themed “Research on current situation and suggestion for the improvement of effectiveness in state authorities of the Vietnamese mining industry”.

It can be said that the major scientific results of the research are (1) the systematic research of the risk management philosophy and achievement in RAG, (2) the overall study of risk management in Vinacomin in recent years as a case study, and (3) the requisites in transferring the risk management system from German Hard Coal Corporations to the Southeast Asian coal mining industry.

The key content of the research is the transference of the risk management system to Southeast Asia, applied in the case study of Vietnam. The results have been introduced not only in Vietnam, but also in other coal mining industries in Southeast Asia, such as Malaysia and Thailand, in the scope of some strategic and academic conferences and workshops, and other publications\(^\text{517,518}\). These could be considered as a valuable contribution for the improvement of safety competence, safety at work and risk management in those countries. However, according to the Development Centre of the Organization for Economic Co-operation and Development\(^\text{519}\),

\(^{517}\) Author’s note: Conference in Malaysia: The 5\(^\text{th}\) International conference on earth resources technology, Kuala Lumpur, May, 2011.

\(^{518}\) Author’s note: Conference in Thailand: The 6\(^\text{th}\) International conference on earth resources technology, Songkhla, Thailand, May, 2012.

\(^{519}\) The Development Center of the Organization for Economic Co-operation and Development was established by decision of the OECD Council on 23 October 1962 and comprises 25 member countries of the OECD: Austria, Belgium, Chile, the Czech Republic, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Korea, Luxembourg, Mexico, the Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom. In addition, the following non-OECD countries are members of the Development Center: Brazil (since March 1994); India (February 2001); Romania (October 2004); Thailand (March 2005); South Africa (May 2006); Egypt and Viet Nam (March 2008); Colombia (July 2008); Indonesia (February 2009); Costa Rica, Mauritius, Morocco and Peru (March 2009) and the Dominican Republic (November 2009).
Southeast Asian countries have economically imbalanced growth rates\textsuperscript{520}, thus the different requisites in countries (both in terms of economic and socio-cultural aspects) could be the objectives of further research. It could also be a suggestion for further research in renovating the reporting of incidents and accidents for more effective information exchange between nations’ authorities and other NGOs. Consequently, adequate measures could be discussed for better prevention.

A handbook in occupational safety and health, and another handbook that integrates all functions and cross-functions of Vinacomin and the subsidiaries could be composed in the upcoming periods.

Furthermore, aside from occupation safety and health, other operative risks should not be overlooked. For example:

- Large direct investment with corresponding capital requirement to achieve a strong competitive position in individual countries;
- Profitability risks from factors beyond the corporation’s control (e.g. financial crises, foreign exchanges, adjustments from the government such as interest rate adjustments, fiscal and monetary policy etc.);
- Fluctuating demand which is difficult to influence in the long-term;
- Profitability risks from world market price fluctuation, even if demand is guaranteed;
- Increased pricing pressure from mining suppliers and the associated service industry;
- Political problems resulting from the importance of raw material production and availability for the country’s economic policies;
- Cultural and attitude problems from expatriates; and
- Extensive international regulation\textsuperscript{521, 522, 523}.

\textsuperscript{520} The Development Center of the Organization for Economic Co-operation and Development (2010), \textit{The Southeast Asia Economical Outlook 2010}
\textsuperscript{521} J. Kretschmann (2010), \textit{Lecture of Risk management in mining} in the Chulalongkorn University, Thailand
\textsuperscript{522} Deloitte Touche Tohmatsu (2003), \textit{Financial Reporting in the Global Mining Industry}, A survey of twenty-one leading companies
\textsuperscript{523} The Ernst & Young (2011), \textit{Business risks facing mining and metals 2011–2012}
Essentially, operative risks (and financial risks) have the same procedure of management as technical risks’. Thus the implementation of a risk management system can also be applied in different fields in mining companies, as long as the other aspects of organization and human resources can be considered, too.

Since motivation seminars should be conducted further to different employees, to maintain the effectiveness of their changing attitudes, it is necessary for managers to be aware of general features of human psychology:

- As something becomes more familiar, we tend to notice less, not more;
- We come to see things not as they are but as (we assume) they ought to be;
- Especially men tend to overestimate their intelligence – and their attractiveness;
- Almost everybody is overconfident – except depressed people;
- We often think we are being rational when we are visceral, and vice versa;
- When a mistake does happen, we often end up blaming the wrong cause – that makes it impossible to learn from mistakes;
- When we are right, we tend to attribute our rightness to our skill in whatever it is we are right about;
- But when we are wrong – we attribute it to chance;
- We are heavily influenced by first impressions, even when we try hard not to be;
- We have a strong aversion to reading and following directions, preferring instead to follow our own intuitions about how something can or should work;
- We are blinded by newer and simpler solutions; and
- We forget (and forgetting may be the biggest mistake of all).

These recommendations could be used both for trainers and trainees, regarding the continual improvement of the management. Risk management brings not only advantages for the companies but also for society as well, as it is a core element of sustainable development. Through the analysis in parts 3 and 4, plausible

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524 J. T. Hallinan (2009)
525 Australian Government, Department of Resources Energy and Tourism (2008)
526 J. Kretschmann, N. Nguyen (2011b)
measures of risk management in Vietnam and in Southeast Asia as a whole could help to promote both economic outcomes (return of prevention) and social benefits (low rate of occupational diseases, incidents and accidents, improvement of safety competence, enhancement of education and training regarding safety at work, etc.).

There are also other research directions for more detailed transference of the risk management system in RAG to Southeast Asia, such as:

- To the authorities/law makers: drafting and issuing laws, other legislative documents on safety and risk management;
- To the education and training system, universities and vocational school: establishing and opening new fields of study (for example: the safety mining industry) with education programs that integrate mining technologies, mining management, legislation, safety management, and risk management etc.;
- To the coal mining managers: enhancement of risk management, safety management and effective safety surveillance force, widening networks, improving know-how transfer, education and training, setting up a health care system for miners, consulting on health issues: sleeping, nutrition, sport and fitness, mentality and psychology etc.

Education and training bring the chance for countries to exchange and transfer experiences, know-how and knowledge⁵²⁷, in which risk management is significant and helpful. Therefore, education and training are also the bridges for mining industries to seize opportunities to improve their production and contribution to society. With these core ideas, this research could engage in the risk management strategy of Vinacomin and in Southeast Asian mining industries in the forthcoming years.

⁵²⁷ Home page of the Society of Mining Professors: The Society of Mining Professors/Société der Bergbaukunde is a vibrant Society representing the global academic mining community and committed to make a significant contribution to the future of the minerals disciplines. The main goal of the Society is to guarantee the scientific, technical, academic and professional knowledge required to ensure a sustainable supply of minerals for mankind. The Society facilitates information exchange, research and teaching partnerships and other collaborative activities among its members. http://www.mineprofs.org/
APPENDIX

1. Surveys

There were two surveys conducted during the transference: one is for the implementation of safety guidelines in general, the other is a follow-up after the seminars.

Interviewees of the first surveys are participants of the motivation seminars and other safety experts.

1.1. Questions and some results of the first survey:

a) Information on the interviewee: Age, position of work, years of experience.

b) How many people do you work with?

c) Has anyone in your staff (in the production unit or in the department) never made mistakes?
   - Yes
   - No

x

d) How you evaluate your staff with regard to safety competence?
   - High
   - Medium
   - Low

x

e) What percentages of your staff have skipped safety rules at work?
   - Less or equal to twenty percent
   - From twenty to fifty percent
   - More than fifty percent

x

f) Name some reasons for the weak safety competence/disobedience of safety guidelines of your staff? List the most important reason(s) first.
   - Production pressure
   - Low safety competence as consequences of garden – agricultural families
   - Ineffectiveness of safety training programs in vocational schools
   - Less effective inspectors
1.2. **Questions and some results of the second survey:**

Records of interviews conducted with participants of the seminars (follow-ups). They are (i) a foreman - Halam Joint Stock Coal Company; (ii) a staff member of the Safety Department - Halam Joint Stock Coal Company; and (iii) a staff member of the Safety Department - Coal Company 86.

a) What have you done so far for safety and risk management at work regarding what you had said in the evaluations and feedback of the motivation seminar?

i. I always ask myself out loud “what else” after assigning duties for my staff in handover meetings to the next shifts.\(^{528}\)

ii. I decided to record and report to a higher level manager all the incidents and accidents in our company, although by doing that, our company has the worst image of safety in comparison with others. I also compose risk maps in our company, implemented in all production units and updated every day. We keep these risk maps updated.\(^{529}\)

iii. I recognize that a risk map is useful for our production unit but we have not yet applied it.\(^{530}\)

b) Please share some challenges you encountered during the implementation. List the most challenging first.

i. At the very beginning, I must force myself not to forget the question, as I used to ask myself in silence. But then I decided to speak out loud. In the beginning, my assistants did not answer the question; they kept silent most of the time.

ii. I was blamed by colleagues from other companies for the higher rates of incidents and accidents, but then the Head of Safety Management Department in Vinacomin applauded me for my work.

iii. After the training seminar, we were so busy with production. In addition to my daily duties as a safety officer, I also took on the duty of training for recruitment. Therefore, I could not develop the use of the risk map.

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\(^{528}\) Author’s note: Follow-ups 6 months after of the safety seminar in the company.

\(^{529}\) Author’s note: Follow-ups 18 months after of the safety seminar in the company.

\(^{530}\) Author’s note: Follow-ups 6 months after of the safety seminar in the company.
c) Please share some advantages of your performance. List the most important thing first.

i. My co-workers support me by discussing and exchanging their ideas after the question has been asked. We could find better solutions for the work performance.

ii. We can recognize our weakness in safety management and discover the measures to improve the situation. We overcame the pervasive problem of form over substance and concentrated on the effects of risk management.

iii. (Could not answer this question as does not use risk map)

d) Please share the results/consequences of your performance. To date, what is the most important improvement?

i. For a very long time there has been no serious accident in our production unit. But I do not think I am very good in risk management. However, I will tell myself and my colleagues not to slack off. The most important thing is safety at work, as it helps my colleagues to be comfortable to go to work and go home happy at the end of each shift. I think I can inspire my workers in personal safety at work, too.

ii. We update the potential risks everyday and have better control. Coding of risks’ categories help us systematically in risk management procedure.

iii. I really regret not being firm with regard to obedience of safety guidelines from some of my staff. For example, when the workers who measure the CH_{4} informed us of the high density, we still let other workers continue working, and, as a result, fatal accidents took place.

2. Structure of a typical seminar in DSK: the basic seminar for safety surveillance

Attendance: Safety surveillance force in Prosper - Haniel coal mine and Auguste Victoria coal mine (14 employees)

The seminar was conducted in 4 days:

- Day 1:
  - Reasons for more safety at work;
  - Rights and responsibilities in safety at work;
  - Roles of safety officers;
- The internal OSH system, rules and regulations; and
- About the BG RCI.

- Day 2:
  - How does an accident happen?;
  - Accidents at work, process of accidents;
  - How does an occupational disease happen?;
  - Occupational diseases; and
  - Introduction to risk analysis.

- Day 3:
  - Behaviors;
  - Movement of colleagues with safety – concern behaviors;
  - Motivation through conservation; and
  - Security dialogues practice.

- Day 4:
  - Lectures;
  - Cases study;
  - Feedback; and
  - Course evaluation.

3. Time schedule of the 4 - day seminar in DSK

- Introduction and motivation: 30 minutes;
- Theoretical inputs;
- Practical sessions;
- Preparation for follow – ups: 30 minutes; and
- Feedback and evaluation: 45 minutes.
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30</td>
<td>Greetings, Introduction, Self introduction of the referee and participants, Introduction of the seminar’s structure</td>
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<tr>
<td>07:30</td>
<td>Summary of accidents’ process</td>
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<tr>
<td>07:30</td>
<td>Case study: ‘Why must staff and managers behavior safely according to safety regulations?’</td>
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<tr>
<td>07:30</td>
<td>Lectures High security, stop harness, rescue from the harness</td>
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<td>Short break</td>
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<td>07:30</td>
<td>Short break</td>
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<td>Short break</td>
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<tr>
<td>09:15</td>
<td>Objective reasons for more safety / quality of work safety in operation</td>
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<td>Accidents at work. Process of accidents</td>
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<td></td>
<td>Movement of colleagues with safety – concern behaviors</td>
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<td></td>
<td>Fire and explosion protection</td>
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<td></td>
<td>What worked well in the implementation?</td>
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<td></td>
<td>Short break</td>
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<tr>
<td>11:00</td>
<td>Legal basic: Basic obligations of employers/ Guarantor position of managers/ Obligations of employees</td>
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<td></td>
<td>Development contexts of occupational illness</td>
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<td>Occupational diseases</td>
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<td>Safety dialogue</td>
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<td></td>
<td>Motivation through conversation</td>
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<td></td>
<td>Commemoration of training mine under safety aspects</td>
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<td></td>
<td>Where there were difficulties in the implementation?</td>
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<td></td>
<td>Short break</td>
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<tr>
<td>11:00</td>
<td>Lunch time</td>
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<td>Lunch time</td>
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<tr>
<td>13:00</td>
<td>Roles of the safety surveillance force: Requirements and tasks</td>
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<td>Dangers recognized, dangers warned: Introduction to risk analysis</td>
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<td></td>
<td>Safety conversation practice</td>
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<td>Evaluation of committing</td>
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<td></td>
<td>Approaches for dealing with implementation problems</td>
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<td></td>
<td>Short break</td>
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<tr>
<td>13:00</td>
<td>Overview of the structures of internal OSH system: the rules and regulations (tasks/functions of the BG RCI)</td>
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<td></td>
<td>Application of hazard analysis: a practical example</td>
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<td></td>
<td>Summary of the first 3 days</td>
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<td>Personal safety programs</td>
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<td>Preparation for the feedback</td>
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<td></td>
<td>Strategies of safety surveillance</td>
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<td></td>
<td>Short break</td>
</tr>
<tr>
<td>14:30</td>
<td>Presentation the results of the personal safety programs</td>
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</tbody>
</table>

**Resource:** Safety and environment

**Service department:** BB E22 Mining training center
## 4. Education for safety mining experts after Mining ordinance (3 weeks) - Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Content</th>
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<td>► Basic knowledge of danger factors</td>
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<td>► Decision of analysis • Transparence of a decision</td>
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<td>► Basic of noise and vibration</td>
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<td>● Practice and experiences</td>
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<td>● How can I get information about hazardous materials</td>
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<td>► Announcement of results from final test</td>
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Resource: Safety and environment  
Service department: BB E22 Mining training center
5. Follow-ups of the seminar for safety surveillance

Each participant was delivered a form for their individual safety program to fill in (name, function, company, main topic). After 6 weeks, they would gather again to present their programs at work.

Persönliches Sicherheitsprogramm

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<td>Grundausbildung Sicherheitsbeauftragte</td>
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Mein persönliches Sicherheitsprogramm

Name:

Tätigkeit:

Bergwerk:

Thema:

Fachbereich: BB Servicebereich Belegschaft
Sicherheit und Umwelt BB E2 Personalentwicklung
6. List of participants in motivation seminars of the pilot safety training program in mines (Vietnam)

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<th>STT/No</th>
<th>Name</th>
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<th>THẠM SIÊN / YEAR OF EXPERIENCE</th>
<th>VỊ TRÍ CÔNG TÀI / POSITION</th>
<th>CHỨ Ki / SIGNATURE</th>
<th>DIỄN THOẠI / CELLPHONE</th>
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<p>| 8      | Ước Minh | 1971 | 17 | hương kuyết | nhân viên | 0986482410 |       |
| 9      | Nguyễn Huy Hùng | 1969 | 20 | Sơn | nhân viên | 0122259485 |       |
| 10     | Nguyễn Anh Thơ | 1972 | 13 | PCC, PK, K10 | nhân viên | 0904790066 |       |
| 11     | Bùi Anh Đinh | 1984 | 18 | PK, PK, K10 | nhân viên | 0977094096 |       |
| 12     | Nguyễn Văn Nguyễn | 1964 | 26 | Trường, PK, PK, PK, PK, PK | nhân viên | 0309779270 |       |
| 13     | Trần Văn Trí | 1953 | 40 | PK, PK, PK, PK, PK | nhân viên | 1904 623 830 |       |
| 14     | Đặng Văn Dương | 1957 | 40 | PK, PK, PK, PK, PK | nhân viên | 0301 235 23 |       |
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<th>Thâm niên / Year of experience</th>
<th>Vị trí công tác / Position</th>
<th>Chữ ký / Signature</th>
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xvii
7. Slides of safety training seminars in mines (in Vietnam - translated)

**OCCUPATIONAL SAFETY AND HEALTH AT WORKPLACES: RISK MANAGEMENT — PHILOSOPHY AND APPLICATION**

Moderator: Tri Hieu Ngoc Nguyen
Hanoi University of Mining and Geology
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**Why we need to manage risks?**
- No one can avoid all risks
- There is no business without risks
- Loss and damages become very expensive if they cannot be recognized and dealt with
- Risk avoidance or minimisation prevent damages or harms and increase productivity
- Risk management assures of sustainable development

**Incidents, accidents and occupational diseases**

Source: Internet

**Incidents and accidents in mines**

Source: Internet

**Goals of risk management**
- Coverage, early detection and assessment of risks
- Initiation of appropriate precautionary and safeguarding measures
- Creating a balance between security and safety interest and value adding or earning interests
- Risk management system has to be adapted to the company’s strategy

**Definitions**
- **Risk:**
  - The results with negative consequences
  - The possibility that the actual result of entrepreneurial activity differs from the expected results
- **Chance:**
  - The results with positive consequences

**Risk and Chance — Yin and Yang**

**Definitions**
- **Risk management:**
  - Procedure of:
    - Identification
    - Analysis
    - Assessment
    - Treatment with risk
    - (Report)
  - Special function, integrates into other management function
  - Aggregation of identification, protection and reduction of loss, damages and negative influences from risks
Definitions

- Risk and Chance Management (RCM):
The methodology in management which not only concerns about risks but also takes advantage brought by chances

Definitions

- Risk management strategy:
A process for identifying, assessing and managing risks and uncertainties, affected by internal and external events or scenarios, that could inhibit an organization's ability to achieve its strategy and strategic objectives with the ultimate goal of creating and protecting shareholders' and stakeholders' values

Definitions

- Risk management system (RMS):

RAG Risk management system

Impact factors to RM system

- Transparency
- Information
- Communication

Procedure of risk management

Plan

- WH questions in RM
  - Who
  - Why
  - What
  - How
  - What resources
  - When
  - etc.
Check
- Evaluation the results that have been done for better improvement
  - Advantages
  - Disadvantages
  - What can be done for better improvement?
- Comparison with aims of risk management standards, guidelines etc.

Identification
- Critical step of the procedure
- Supplies almost general information about risks which can occur during a project or business activities

Example of a simple Fault Tree Analysis in combination with Human Potential Error Identification

Analysis
- A systematic use of available information to determine how often specified events may occur (likelihood, probabilities) and the magnitude (losses, earnings) of their likely consequences

Tool of risk analysis
- A risk map

Portfolio of risks
Assessment

- A process used to determine risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risks levels or other criteria
- From the results of risk assessment, the priorities and treatment of risk should be listed out

Assessment’s results

Treatment with risks

- The selection and implementation of appropriate options for dealing with risks
  - Acceptance / Set - Bearing
  - Reduction
  - Sharing / Rolling over
  - On – going market
  - Retain the risks
  - Avoid the risks

Treatment with risks

Measures to treat with risks

- Think small
  - The tiniest small change in circumstance can have a big impact
  - The small things can be seen in working places, not in the management board

7 golden rules in risk management:
Starting point to systematically cut accidents

- Take leadership commitment
- Identify hazards and risks
- Set safety and health targets
- Use safe and healthy technology
- Ensure safe systems
- Improve qualification
- Invest in people

(Reference: International Labour Organization)

1. Leadership and commitment

- Did you make safety and health your top priority?
- Do your managers and employees know of your priority?
- Are you setting an example in respect to OSH?
- Do you instantly react to unsafe conditions or behaviour?
2. Identify hazards and risks
   • Do you carry out a systematic risk management?
   • Do you include maintenance, repairs and procedures for unplanned interruptions?
   • How often do you update your risk assessment?

3. Set safety and health targets
   • Do you have a written OSH – politics?
   • Do you have a reliable reporting system on work accidents, occupational diseases and near misses?
   • Do you systematically evaluate your OSH – statistics?
   • What are your OSH – targets?
   • How do you investigate and evaluate work accidents?

4. Ensure a safe system (1)
   • Do you have a certified safety management system?
   • Do all your managers (top level, medium level, lower level) know about their personal responsibility and duties for OSH?
   • Do you have written documents for the delegation of employer's duties?
   • Do you have a clear organisational structure for OSH?

4. Ensure a safety system (2)
   • Do you have required OSH – competence (physicians, safety specialists, specialized experts etc.) in your company?
   • Do you prepare and update the necessary plans and documents to run your mine safety, even for emergencies?
   • Do you have OSH – committees in your company?
   • Do you and your managers inspect all your workplaces regularly?

5. Use safe and healthy technology
   • Do you consider OSH – matters when ordering new machinery or plant?
   • Do you use efficient measuring equipment, to control flammable and respirable dust, gas and air?
   • Do you use all machines in a safe way and regularly check safety installations?
   • Do you care for a safe mine access and egress?

6. Control and improve qualification and knowledge of your staff
   • Is mining education available for every miner?
   • Do you define the necessary qualification for each workplace?
   • Do you have a plan for training and instruction?
   • How do you document regular instructions?
   • How do you assess that instructions are fully understood?
   • Do you consider communication problems such as languages problems or illiteracy?

7. Invest in your most valuable capital: Motivate your employees
   • Are your employees involved in the company’s OSH – politics?
   • Do you collect your employees ideas for improved safety systematically?
   • Do you motivate your employees to report near misses and incidents?
   • Do you practice open communication and information politics?
   • Do you acknowledge good safety performance?

Experience from RAG
Reduce risks by eliminating accidents
As a first step, technical measures were introduced as a focus of the safety initiative
Experience from RAG
Reduce risks by eliminating accidents
In a second step, organizational measures were introduced as a focus of the safety initiative.

Experience from RAG
Reduce risks by eliminating accidents
In a third step, employee-related measures were introduced as a focus of the safety initiative.

Reduce risks by eliminating accidents

Application in collieries in Vietnam
- Measures
  - Technology
  - Organization
  - Personnel
- Organization
  - Plan
  - Do
  - Check
  - Act

Influence factor to RMS
- External factors
  - External to an organisation
  - Beyond the control of companies
  - Impact to individual company and companies in industries
- Geological conditions
- Economic conditions
- Political / Legal conditions
- Socio - cultural conditions
- Technological conditions

Influence factor to RMS
- Internal factors
  - Internal to organisation
  - Impact on organisations’ objectives
  - Find out strengths and weaknesses of companies
  - Human resource
  - Finance and accountancy
  - Marketing
  - Production
  - Purchase
  - Distribution / Sale
  - Etc.

Cultural impact elements
- Anthropological aspects
- Lifestyles, values, customs, traditions, norms and rules, business ethics, beliefs, languages, social conditions, work ethics, family, social networks, friends, etc.
Causes from accidents

Practice

- Application of risk management procedures in your workplaces:
  - Plan – Do – Check – Act
  - Identify – Analyse – Assess – Treat – (Report)
- Name some advantages and disadvantages of the application in your workplaces (in reality)

THANK YOU FOR YOUR ATTENTION
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SUMMARY

The scope of the research was defined by the technical risk management (of which is occupational safety and health) both in German Hard Coal Corporation (RAG) and the Vietnam National Coal, Minerals Industries Holding Corporation Limited (Vinacomin) – the representative of the Vietnamese coal mining industry in recent years. In DSK, (principle) measures to deal with risks were studied and in Vinacomin, 3 coal companies – which were chosen to be the representatives of the three areas of Quang Ninh coal basin – were also taken in the research for the experiments of the risk management system’s transference.

Additionally, the contribution and acquisitions of the research, both in theory and practice, were also discussed on risk and chance management, sustainable development and the significant role of education and training. Base on the decision of the dissertation’s structure, appropriate methods of the research were also offered. The results of the research were briefly described and mostly mentioned in different publications and presentations.

Chapter 1 began with the overview of risk management and technical risk management. From the comparison of other definitions of risks and risk management, the author recognized that the particular difference of risk management in Germany from other countries: the consideration of chances/opportunities. Another definition of risk and risk management were mentioned in this chapter. Also, risk management was analyzed by a part of strategic management and a management function. Classification of technical risks and the main impact factors in coal mining industry were made. Through the analysis, technical risk management in coal mining industry in Vietnam should be based on adjustment and adaptation of human attitudes (of authorities and workers) in integration with other management functions.

In chapter 2, the risk management process and risk management system in German coal mining companies were explained. Theoretical and practical issues in RAG Corporation were also analyzed to see the outstanding achievements of the industry in the last decades. For example, they are the elimination of fatalities and the reduction of accidents per one million working hours that help the increasing of productivity. Adequate measurements in techniques, organization and people are the foundation of those achievements. Since people are the most important resources of companies, RAG has been implementing measures that motivate their staff. The improvement of their safety awareness and self – implement at work are the combination of abilities and willingness, as well as knowledge and other motivation. Thus, education and training for better knowledge and skills as well as how to motivate the staff becomes the core of the transference. This is the main subject for the following chapters of the dissertation.

Chapter 3 talked about the case study of the Vietnamese coal mining industry. The main content of this chapter was about the “state-of-the-art” in risk management. General information, features of technology, infrastructure and labor force were described. These are the basis for the risk management in Vinacomin, which mentioned both the advantages and disadvantages. Strategy of this Corporation and some subsidiaries in upcoming years were also summarized. According to the strategy, coal output from open – cast mines would be reduced from 23.3 million tons in 2014 to 8 million tons in 2030. Meanwhile, from underground mines, output would be accelerated from 33.5 million tons to 47 million tons in the same period. This is one of the challenges in risk management in Vinacomin in the forthcoming years, as geological in depth excavation becomes more complicated. The other challenges were also described in this chapter, such as: in laws, regulations, risk management outlines and technological norms, in technical equipment, in organizational and operational procedures, in safety awareness among employees – for the shortage of safety culture and sufficiently qualified employees, which also leads to the situation of the pervasive phenomenon of
temporary and non-committal compliance or a preference for form over substance, and the pressure from the Board to increase the production.

Based on the measures in risk management of the RAG Corporation, the implementation of the risk management system in the Vietnamese coal mining industry has been offered by the transference of knowledge and building skills, and the motivation for the application. This transference should be conducted by multi-level approach: national level, corporate level (the whole corporation and other subsidiaries), department level and section level (production unit). Improvement in education and training, both in contents and methods at various levels in ministerial authorities, corporations, and educational institutes are the key elements of the transference. Besides, requisites of the transference from one of the most developed coal mining industries in Western Europe to agricultural countries in Southeast Asia are also discussed in both economic and socio-cultural aspects. These are the main contents of chapter 4 and 5.

Initially, the transference can show its acquisitions in the pilot program held in different collieries of the Vietnamese coal mining industry. Moreover, across the boundary of the pilot program, the usages of the training methods adopted from Germany could be widely applied with the supports of the Vietnam National Coal, Minerals Industries Holding Corporation Limited (Vinacomin) in frame of the Project “Technological renovation and modernization in mining industry to 2015, outlook to 2025” with the subtheme “Research on current situation and suggestion for the improvement of effectiveness in state authorities of the Vietnamese mining industry”.

It can be said that the major scientific results of the research are (1) the systematic research of the risk management philosophy and achievement in RAG, (2) the overall study of risk management Vinacomin in recent years – as a case study, and (3) the requisites in transferring the risk management system from German Hard Coal Corporation to the Southeast Asian coal mining industries.

The key content of the research is the transference of risk management system to SEA, applied for the case study of Vietnam. The results have been introduced not only in Vietnam, but also in other coal mining industries in SEA, such as Malaysia and Thailand, in scope of some strategic and academic conferences and workshops, and other publication. These could be considered the valuable contribution for the improvement of safety competence, safety at works and risk management in those countries. However, according to the Development Centre of the Organization for Economic Co-operation and Development, SEAn countries have economic imbalance growth-rate; thus, the different requisites in countries (both in economical and socio-cultural aspects) require further researches. It could also be other suggests for further researches in renovating report of incidents and accidents for better effects of information exchange with nations’ authorities and other NGOs. Consequently, adequate measures could be discussed for better prevention.

Education and training bring the chance for countries to be exchanged and transferred with experiences, know-hows and knowledge, in which is risk management. This is also a bridge for mining industries to seize opportunities to improve their production and contribution for the society. With the core ideas of education and training in the transference the risk management system from RAG to Vinacomin, this research could engage in risk management strategy of this corporation in the forthcoming years.
ZUSAMMENFASSUNG

Die Dissertation besteht aus 5 Kapiteln zusammen mit der Einführung und der Konklusion und weiteren Recherchen.


Kapitel 3 beschäftigt sich mit dem Ist-Stand des RM bei Vinacomin. Generelle Informationen, Besonderheiten der Technologien, Ausrüstung und Arbeitskräfte werden auf Vorteile und Nachteile analysiert. Um in Zukunft besser dazu stehen sollte Vinacomin die folgenden Herausforderungen überwinden: (1) höhere Sicherheit im komplexer werdenden Untertagebergbau unter komplizierten geologischen Voraussetzungen; (2) Verstärkung der Gesetze, Normen und Richtlinien zum Thema Sicherheit und RM; und (3) Sicherheit und RM müssen im Wesentlichen sein.


Erneuerung und Modernisierung im Bergbau bis 2015, Missionarstätigkeit bis 2025, mit dem Unterthema „Forschung über aktuellen Stand des vietnamesischen Bergbaus und Vorschläge für die Verbesserung der Wirksamkeit der staatlichen Behörden“.


Die wirtschaftliche Entwicklung der südostasiatischen Länder ist jedoch nicht gleich (ökonomische und sozio-kulturelle Unterschiede), hier ist Raum für weitere Forschung.
