

The Risk Management Framework to Strategic Human Resource Management

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Abstract

This study deals with complexity of human factors and provides insights to managing human factor based risks. The offered risk management framework to strategic human resource management provides an integrated and proactive approach for tackling important human factor risk considering human factors with its two interconnected roles. Source and manager interface are critical points to achieving business objectives in financial, strategic and operational context. The offered framework model allows an effective framework for applying the combination of the human resource and risk management principles for managers. The model uses a system approach to manage human performance and capability limitations. In this article, the proposed full-set RSFs/RIFs taxonomy and new score formula are weighted with Analytic Network Process Method in the context of new model.

Keywords: Human Factor, human resource management, risk management, risk analyze, risk score, strategy.

JEL Classification Codes: M100, M120, M190

1. Introduction

Risk management to human factor is the process of identifying and assessing human factor based risk and then developing strategies to strategic human resource management. It is also the holistic, proactive and systematic consideration of human capabilities and limitations. The effective management of human resource based risks is a cornerstone factor of corporate success. Instead of decreasing the importance of human being, technological development has contributed the opposite. Technology, in the absence of human resources is not yet self-sufficient. Human factors are still essential in most functions and activities performed by businesses where either intense or moderate technologies are used. Managing human factors based risks requires both more systematic decision

frameworks and new assessment tools such as risk shaping factors and risk score. Offered model in this study includes these emerging requirements to holistic and strategic risk management of human factor.

Although most of current research fully assumes corporate risks, it cannot be said that the human risk management concept is treated sufficiently. Business leaders recognize the link between business performance (financial and operational performance) and the personnel within their organization. Moreover, they understand that personnel-related issues need to be at the heart of the boardroom agenda. Managers are being encouraged to implement human factor's risk management strategies that support the organization's business objectives and increase accountability and transparency around human factor management and reporting. The bottom-line: Human Factor based risks are increasingly seen as a strategic linchpin — one that needs to work closely with operations, finance, and other corporate departments to help drive business strategy and success (PricewaterhouseCoopers, 2008).

New Human Factor Risk Management (HFRM) model is structured by managing activities of human based risks for businesses and provides a comprehensive and coherent framework for the evolution and management of human factors. The Human Factor Risk Management (HFRM) model continues to anticipate potential human factor based risks and develops appropriate responses for various scenarios. New Human Factor Risk Management (HFRM) model can help provide a more precise understanding of risk factors associated with the human element and to furnish insights on their appropriate identification and prioritization via scoring and management.

This study reviews both leading enterprise risk management (ERM) guidelines and strategic human resource management (SHRM) literature in the development process of the Human Factor Risk Management (HFRM) model. These are reviewed in view of their context of human factor based risks.

In the Enterprise Risk Management field leading guidelines *are reviewed in terms of human factor based context* such as Enterprise Risk Management–Integrated Framework and Application (The Commission of Sponsoring Organizations of the Treadway Commission, 2004); Overview of Enterprise Risk Management (Casualty Actuarial Society Enterprise Risk Management Committee, 2003); Enterprise Risk Management Specialty Guide (Society of Actuaries, 2006), Risk Management Australian/New Zealand Standard AS/NZS 4360:1999 (Standards Australia/Standards New Zealand, 1999); Risk Management Standard (FERMA, 2003); Risk Management Standard (The Institute of Risk Management; Association of Insurance and Risk Managers and ALARM, 2002); Understanding ERM–An Emerging Model for Building Shareholder Value (KPMG, 2000); Basic Frameworks for Risk Management (NERAM, 2003); Enterprise Risk Management - A Analytic Approach (Tillinghast-Towers Perrin, 2000); Risk Management: Guideline for Decision-Makers (CAN/CSA-Q850-97) (Canadian Standards Association, 1997).

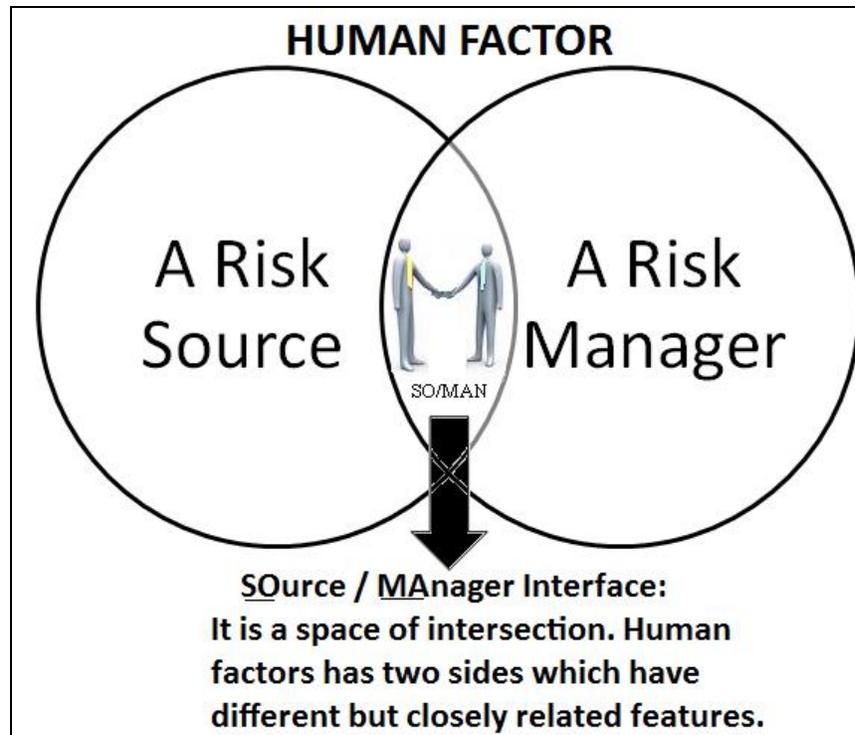
The Strategic Human Resource Management (SHRM) literature is rooted in 'manpower' planning, but it was the work of influential management gurus (e.g. Ouchi, 1981; Peters & Waterman, 1982), affirming the importance of the effective management of people as a source of competitive advantage, that encouraged academics to develop frameworks emphasizing the strategic role of the HR function (e.g. Beer et al., 1985; Fombrun et al., 1984) and attaching the prefix 'strategic' to the term 'human resource management' (Bratton, 2001).

A number of weaknesses in current literature and works on both ERM and human resource management have been identified. These weaknesses come mostly from a single acting approach to human factors, the absence of internal strategies, and lack of systematic and holistic approach for managing human based risks.

SHRM and ERM literature have generally focused on the risk source dimension of human factors thus ignored or insufficiently focused on the dual role of human factors. In addition, human based risks did not use taxonomy and related risk scoring in these works. The Human Factor Risk Management (HFRM) model supports SHRM and whole management efforts via considering the multi-dimensional nature of human factors. Our model is designed as a combination of holistic risk management (to financial, strategic, operational and threat risks) and strategic human resource management.

Human factors are some of the most important soft sides of any corporate management system. Soft side refers to the development and management of human capital created and affected by human resources. Human resources are one of the fundamental sources of risks. Additionally, human resources manage and control the hard side of corporate management systems. For this reason, human factors are part of the system as well as acting as risk controller and manager. Thus, Human factors are a leading element influencing corporate management systems and risk management. This assumption is the basis of the HFM model. Determination requires different and holistic approach for human resources from other enterprise resources (see fig. 1.).

Figure 1: Two Sides of Human Factor



This study provides an integrated and proactive approach for tackling important human factor risk considering human factors with its two interconnected roles. Source and manager interface are critical points to achieving business objectives in financial, strategic and operational context. This interface is a space of intersection. Human factors include two sides, which have different but closely related features. Human resource management (HRM) models provide no clear focus for any assessment of the HRM–performance link. New Human Factor Risk Management (HFRM) model set an interconnected relationship between corporate strategy, risk management strategy and human resource management strategy. If properly implemented, the Human Factor Risk Management (HFRM) model will improve corporate performance, financial performance, shareholder interest and competitiveness. Human Factors Management models should be embedded in planning process in management as well as risk management systems. In order to meet the needs of dynamic business environment more effectively, managers have to move beyond traditional approaches to human resources management and enterprise resource planning. This study offers a new proactive approach for managing human based factors, because HFM model gives systematic and user- friendly process for managers and decision makers. Also, this process is supported by RSF/RIF taxonomy, risk score formula to acquiring timely and optimum results. Human factors require a different approach from other risk types since they have different characteristics from other enterprise resources. For this reason, Human Factor Risk Management (HFRM) model can help improve HR related skill development throughout the company. Current human resource management methods and models are

focused on roles ranging from responsibility and organizational efficiency to personnel reinforcing, processes of learning, self-management, or individual risk-competent behavior. When considered systematically, the human factor is a part of the holistic picture. New HFRM model reflects the reality of corporate resource constraints.

In this model, a new full-set of risk shaping/influencing factors (RSF/RIF) taxonomy has been developed and used by authors, which is weighted by the analytical hierarchy process (AHP). There is reviewed many performance shaping factor (PSF) taxonomies in HRA methodologies to develop new RSF/RIF taxonomy. In this study, authors suggest a new RSF/RIF taxonomy for use in management of corporate risks via a human centered approach. RSF/RIF has been constructed from the collection and review of existing performance influencing factors (PIF) taxonomies. RSF/RIF is defined as “factors, which influence human risk rates as considered in human based risk analysis”. Human factors formed and being evaluated by their risk shaping/influencing factors (RSFs/RIFs) in the process of new Human Factor Risk Management (HFRM) model.

When implementing the HFRM model, one of the most critical of all decisions is that of the rating of human based risk factors. Saaty’s Analytical Hierarchy Process (AHP) is used for weighting and prioritization of RSFs/RIFs taxonomy in new Human Factor Risk Management (HFRM) model. The analytic hierarchy process was developed by Saaty to provide decision makers with the means to deal with complex decisions involving many attributes of varying degrees of subjectivity. Its purpose is to present a method “whose application reduces the study of even formidably intricate systems to a sequence of pairwise comparisons of properly identified components” (Saaty, 1980).

The study is organized into four main sections. After the introduction, the drivers of the human factor risk management model are explained in section two. The methodology of this study is provided in the third section. A verbal model is used for developing the Human Factor Risk Management (HFRM) model, which contains a full-set of risk shaping/influencing factors (RSF/RIF) and a score formula. Finally, we conclude with a summary and significance of new model as well as with a brief discussion of future research possibilities.

2. Drivers of the Human Factor Risk Management Model

The Corporate management systems, financial risk management and HFM affect human resources actions. Human Factor Risk Management recognizes that people do not always understand, communicate or perform consistently. Each individual brings to the workplace a unique background and technical ability, and has different needs and priorities (COSO, 2004, p. 5.).

Human factors have a dual role in corporate management, risk management and human resource management:

A source of risk: e.g., human resource barrier to implement corporate management plans or achieving corporate goals via unqualified person, human failures and errors, collusion of two or more people, fraudulent activity, judgment mistakes, health and safety, malfeasance, realities of human frailty in making business decisions, low performance, unethical behaviors, ability level of management to override HFM decisions.

A manager of risk: e.g., a person who puts corporate management systems and human resource management into practice. Human resources establish the corporate mission/vision, strategy and objectives and put HFRM mechanisms in place. He/she is an important part of the strategy for dealing with human factor based risks, e.g., dealing with fraud risk, all management and organization based risks.

Both sources and managers of risk, human resources have dual roles in corporate management systems and risk management. Human resources are one of the keys to success in corporate management systems. For this reason, the aforementioned dual roles (risk source and risk manager) require a different approach to both human resource management and the corporate management systems. This is due to the fact that the human element has different, highly dynamic and hardly controllable characteristics from other corporate sources.

Both machines and humans are subject to errors and therefore influence the quality of products and services. The way risk is assessed for machines and humans is very different. Automated processes are a known factor and are controllable. A machine delivers statistical data. Once the setup is made, operations can be repeated and the result will be almost always the same. Humans are not able to work with the same constancy as machines (Dayer, 2008).

An effective corporate risk management system requires both a strong organizational culture and a robust management framework to implement. Corporate culture is a significant determinant of organizational behavior and performance. The organization's culture affects HFM policy and performance. For this reason, corporate culture should take into account effective HFRM model. O'Donovan's definition of culture encapsulates the organic nature of the phenomenon and how it manifests in organizations; her business needs driven typologies reflect a systems perspective and a moral perspective (O'Donovan, 2006). Corporate culture is defined as a way management and everyone else in the organization feel about risk - recognizing that feelings, attitudes and perceptions about risk will influence how that is managed (Rossiter, 2001). The most successful organizations are those that can capture the hearts, minds and energy of their employees to work toward a common goal. The "right" culture can then support the successful introduction of the "right" human resource management program that is linked to the achievement of organizational goals and value creation (Rossiter, 2001).

Considerations and concerns for human factors are at the core of the management of any endeavor, but corporate management has traditionally not been human-centered. Business Management focuses on such things as the policies, procedures, planning and bottom line results of business activities. However, the organizational game is changing in a dynamic fashion. Managers are becoming increasingly aware of the importance of the human element particularly as it relates to the management of organizational change. Managers and HR executives will find that working as partners is the only truly effective means to move through the cataclysm of change in a way that is least harmful to their organization and its workforce and to offer workers a positive revitalization of their work world. Human resource executives become involved in Human Factor Management HFM planning during the assessment and control stages (Frederickson, 2008).

The drivers for developing a new Human Factor Risk Management (HFRM) model are as follows:

1. integration of human factor risk management into the organization as a part of achieving their overall goal of a managed corporate culture
2. increase the human factor contribution to company functions and activities
3. meet requirements for managing human factors
4. reduce costs arising from human performance limitations and add value through improved human performance
5. meet demand of business owners and high level managers

Desired outcomes from new HFRM model, taxonomy and score formula are as follows:

1. human factors will be considered as leading risk factors in corporate management system and organization
2. human based factors will be managed to achieve corporate objectives (e.g., financial outcomes, operational performance)
3. threats and opportunity based awareness and responsibility will be increased amongst the managers and other personnel in the organization
4. human factor management will be considered an essential part of the business planning process

This Human Factor Risk Management (HFRM) model allows an effective framework for applying the combination of the human resource and risk management principles for managers. The model uses a system approach to manage human performance and capability limitations. Management thinking that emphasizes the interdependence and interactive nature of elements internal and external to an organization (Business Dictionary, 2008). The system approach to management based on general

system theory – the theory that says that to understand fully the operation of an entity, the entity must be viewed as a system. This requires understanding the interdependence of its parts (Certo, 2002). System approach to management is defined as identifying, understanding, and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives (Hoyle, 2006).

A systems approach to Human Factors (HF) recognizes that people are one part of a wider system. The objective is to develop truly integrated systems in which users, equipment and the operating environment are appropriately matched for optimal, safe and effective use and performance. Human factors are the scientific discipline concerned with the understanding of interaction amongst other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well being and overall system performance (Ryan, 2005).

A systems approach also involves (Ryan, 2005):

1. Incorporating active consideration of the human element as part of systems design and assessment
2. Applying relevant HF principles and standards
3. Integrating HF based management methods and processes into the corporate business systems, processes and risk management framework

The Human Factor Risk Management (HFRM) model intends to maximize the benefits of existing functions and activities in all departments via a human-centric approach. Expected additional benefits are includes:

1. a strategy for human factors risk management across the organization
2. a generic framework, which enables flexible and tailored approaches
3. a systematic managerial tool for the best management of human factors based risks
4. a common language and culture for corporate risk management
5. a tool for increasing human based opportunities and decrease human based threats
6. a common approach for internal monitoring, control, and review
7. a strong managerial tool for continuous control of Human Factors based risks

3. Methodology

The qualitative research methodology and verbal modeling used is in setting up new Human Factors Risk Management model. Additionally, the quantitative risk analysis methodology used in order to aid in the assessment of the human factors. A new full-set of the RSF/RIF taxonomy has been determined and weighted by AHP, and then results are used in the new score formula.

Faced with rapid change organizations need to develop more focused and coherent approaches for managing people. The Human Factor Risk Management (HFRM) model (see fig 2.) allows for the management of human risk (like any risk) to be a continuous process of identifying, analyzing and mapping areas that have the potential to cause threats and can provide an opportunity in implementing system improvements. We developed a model that would allow human risk to be considered systematically and which would gain maximum advantage from tools and processes already existing.

Figure 2: Human Factor Risk Management Model

HUMAN FACTOR RISK MANAGEMENT MODEL – HFRM		
STEP 1	SWOT ANALYSIS	<ul style="list-style-type: none"> • CONTINUOUS COMMUNICATON AND CONSULTATION IN THE ALL STEPS • CONTINUOUS MONITORING AND REVIEW IN THE ALL STEPS
STEP 2	DETERMINATION & ANALYSIS OF HUMAN FACTOR BASED RISKS <ul style="list-style-type: none"> • FULL SET RSF/RIF TAXONOMY • SCORE FORMULA 	
STEP 3	DECISION MAKING TO OPTIMUM RISK HANDLING OPTIONS AND THEIR IMPLEMENTATION <ul style="list-style-type: none"> • ASSUMPTION • AVOID • TRANSFER • MITIGATION 	
STEP 4	ASSESSMENT OF THE HFRM MODEL PERFORMANCE	
STEP 5	IMPROVEMENT OF THE HFRM SYSTEM	

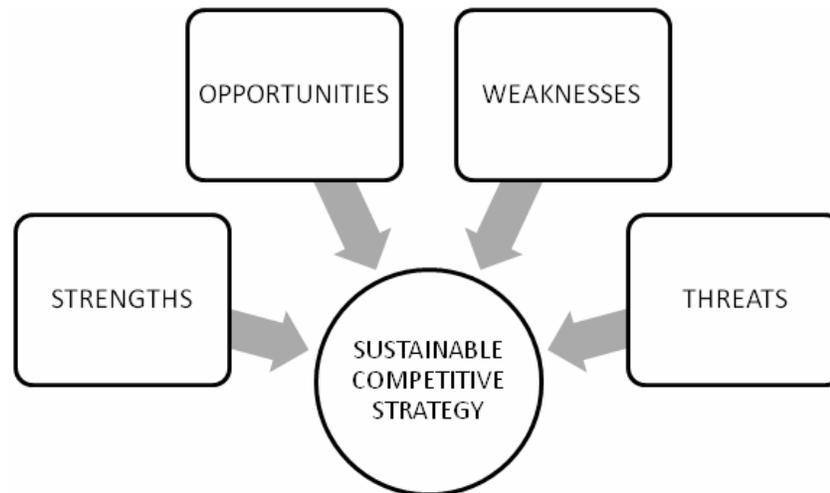
The Human Factor Risk Management (HFRM) model provides a generic framework for the establishment and implementation of the management process within organizations. A number of large companies have recognized the value in adopting some kind of a risk model. The proposed model is primarily a process for applying human factors tools and techniques in a coordinated and systematic way. The model has a number of elements that deal with and link management processes to corporate sustainability. The model also takes into account work ethic, culture, and stakeholder expectations as organizational culture is affected by these concepts. This model can be applied in any industrial and business management segment. Fig. 2 provides an overview of the model and its elements as a continuous loop.

3.1. The Human Factor Risk Management System Elements and Tools

New HFRM process includes a continuous monitoring, review, communication and consultation system along with its five steps. These four steps are integral to the entire HFM process. Communication and consultation will be reflected in each step of the process.

3.1.1. Step 1. SWOT Analysis

SWOT Analysis is a beneficial practical method used for understanding an organization's strategic position. SWOT analysis can help managers identify gaps and opportunities in the human factor management process to improve the process and to increase the ability of the organization to compete on the business market. SWOT (the acronym standing for Strengths, Weaknesses, Opportunities and Threats) analysis is a commonly used tool for analyzing internal and external environments in order to attain a systematic approach and support for a decision situation (Kurttila et al., 2000). This process provides insights to the organization's internal and external positioning, examining internal and external elements that must be factored into future decision-making (BoardSource, 2008).

Figure 3: SWOT Analysis

SWOT analysis can be simply understood as the examination of an organization's internal strengths and weaknesses, and its environments, opportunities, and threats. It is a general tool designed to be used in the preliminary stages of decision-making and as a precursor to strategic planning in various kinds of applications (Radha and Dugger, 2005). SWOT is the first phase of the HFM process. When applied properly, an optimum decision to adopt a human factor based strategy is possible.

Determining a company's internal strengths, weakness, external opportunities, and threats, SWOT analysis helps to provide a good overview of where the company stands competitively. The premise of the SWOT analysis is that a good strategy must be the byproduct of the company's internal resources, capabilities, and situation in the industry. Human resource SWOT analysis deals with the following core questions (Cochran, 2008):

- What makes our people better than employees in other organizations?
- What employee skills and abilities could be improved?
- What skills and abilities do we think will be critical 10 years from now?

SWOT analysis (see fig. 3.) is widely accepted as the first step and a key component of a strategic planning process, providing a framework for business managers to direct human factors. SWOT Analysis can be useful in establishing the HFM Strategy and the implementation of the new HFRM model. It also can be used to review a corporate strategy or position, direction of an organization, or an idea. When SWOT Analysis are done simultaneously for the company and individuals at all levels, there will be flow of organizational energy outward and the organization may be able to achieve various levels of synergies (Leard, 2008).

A SWOT analysis focused on HR involves the identification of the human factors that are favorable and unfavorable to achieving corporate objectives. A SWOT carried out on a Human Resource Department or risk managers in the company may look like this:

Sources of Strengths

- Proactive and innovative management
- Highly motivated staff
- Experienced staff
- Dedicated and talented staff
- Qualified staff
- Young staff
- Tools to improve human resource activities are available and understood
- A strong financial position
- A strong brand name
- Brand loyalty
- Quality product
- Strong knowledge management
- International operations
- Efficient operating procedures
- Good supplier or customer-relations
- Strong promotional practices
- Proactive managing of human based corporate risks

Strengths

What can be considered a company's strength? Identifying company strengths should be easy if one does a thorough analysis of the internal environment. A company's strength is something the company simply does well, or something that is a positive asset. Think of a strength factor as something over which a company has control. For example, the company has control over its core competencies in establishing and implementing them. It also has control over its resource capabilities as well as its corporate balance sheet. A strength factor is always going to be internal to the company. What are the sources of strengths? Strengths can easily be found by examining the company's value chain. Another way to find strengths is through an examination of the functional areas within the company.

Keeping in mind that the company's strengths are those factors over which the company has control, strengths are determined through a thorough analysis of the internal environment and a close examination of the company value chain. Managers can make human resource management one of their strengths. The result will be better risk management, more effective corporate management and greater satisfaction from working with people (Erven, 2008).

Weaknesses

Like strengths, identifying company weaknesses should be easy if one performs a thorough analysis of the internal environment. A weakness is something that the company does not do well and over which it has control. For example, the company has control over its financial picture, but this does not always mean that the money is being managed appropriately. It also has control over its products, but this does not mean that the product is good. Maybe the product is no more than a copy of a competitor's product. Will this give the company a competitive advantage? Not likely.

Sources of Weakness

- Limited human resources and staff
- Service similar to competitors
- No continual evaluation and updating of human resources practices and policies
- Lack of accountability of managers and employees to achieve clear and measurable performance levels
- Old, rundown facilities
- Lack of any computer integration
- Unused capacity
- High inventory costs
- Large amount of obsolete inventory
- No strategic direction
- Sub-par product quality
- Lack of good research and development
- Lack of strong leadership
- Lack of corporate vision
- No product recognition
- Traditional or reactive managing of human based risks

A weakness is internal to the company. What are the sources of weaknesses? Weaknesses, like strengths, can be found by examining the company's value chain or by taking a close look at each of the functional areas. The most important thing about determining weaknesses is to be honest. It is always easy to determine strengths because these are the things of which the company is proud. But does management generally want to admit weaknesses? Probably not. Strategic analysis is no better than the time and effort put into the analysis and no better than the honesty of the evaluation. Therefore, it is essential in the analysis to admit to all weaknesses. Also, keep in mind that something can be a strength factor and a weakness at the same time. For example, a company might have a very motivated workforce (strength), but they might not have the expertise needed to move the company into the next generation product (weakness). In this scenario, the employees can be considered as both strengths and weaknesses.

Opportunities

The next area in the SWOT analysis is the external analysis. After a thorough analysis of the external environment, company management should be able to determine the opportunities and constraints that face their industry. These are things within the environment that the company has absolutely no control over. And, as previously discussed, there are different levels of these opportunities and threats. Some exist within the industry, but others, like economic issues, exist at the macro level. Nevertheless, these are things that have an effect on the way a company conducts business.

What are sources of opportunities? One should examine the external analysis. If a thorough assessment of the external environment was conducted, these opportunities should be easy to spot.

Sources of Opportunities

- New management team, wanting to improve overall organizational effectiveness through organizational development and cultural management program
- Advanced technologies are available to foster more effective human resources activities
- Untapped international markets
- Untapped customer needs
- Large demand for the products produced by the company
- Favorable demographic conditions
- Acquisitions of rival firms or firms in similar industries
- Acquisition of firms that will facilitate backward or forward integration
- Changes in international trade policies

As is evident above, opportunities are factors that exist in the external environment (industry and economy) of which the company can take advantage. Company management cannot control opportunities but they can certainly utilize an opportunity to further the company's strategic position.

Threats

A company has no control over a constraint or threat, but the threat can do a lot of damage to the business if not managed properly.

Furthermore, a SWOT analysis can give management a good snapshot as to where the company is at the present moment. It also helps to assess exactly where the company is in terms of the internal organization. SWOT gives management the best overview from which to determine exactly what steps to take in the near future to improve competitiveness. For example, SWOT might reveal to a company that there is great urgency to make changes in the organization if it wants to remain viable in the market. Thus, while SWOT helps to formulate strategies, it also gives a very thorough, and hopefully unbiased, overview of the company.

Sources of Threats

- HFRM system contribution not recognized by top management in the industrial setting that accepts a common practice of by-pass it by employing external consultants
- High unemployment
- High periods of inflation
- Competition infringing on the market
- New government regulations
- Substitute products
- New innovations that render the existing product obsolete

This step also includes the following activities that are relevant to new model:

- Setting of corporate strategies and objectives
- Determination of corporate risk philosophy
- Survey of corporate risk culture
- Consideration of organizational integrity and ethical values

3.1.2. Step 2. Determination and Analysis of Human Factor based Risks

- Full-set Risk Shaping / Influencing factors taxonomy (RSF's / RIF's),
- Weighting by AHP method and
- Scoring by formula

Human factors influencing the behavior of people and the climate at work, in a way that can increase or decrease achievement level of organizational objective of business management is important (Thevendran and Mawdesley, 2004). These factors encompass most human factors that can have an effect on both human resource management practices and business management systems. These factors may be considered in the basic calculation personnel risk score in the any company. Decision makers and/or managers will use RSF/RIFS and formula for their assessment to make timely and true optimum decision-making. In necessary conditions, each one of the managers can compare of his/her score results with other's to get the most reliable result.

Developing RSF/ RIF from the existing PIF and PSF taxonomies

Performance Influencing Factors (PIFs)), are factors that combine with basic human error tendencies to create error-likely situations. In general terms PIFs can be described as those factors, which determine the likelihood of error or effective human performance (Embrey, 2000). Performance influencing factors can be divided into workplace related factors and human related factors (ExproBase, 2008).

PIF and Performance Shaping Factors (PSFs) are interchangeable. Like the PIFs, the PSFs use to categorization of related human factors.

“The external PSF include the entire work environment, especially the equipment design, the written procedures, and oral instructions. The internal PSF represent the individual characteristics-skills, motivations, and the expectations that influence one's performance. The stressor PSF are the psychological and physiological stresses which resulted from a work environment in which the task demands for operators in the system, do not conform to their capabilities (Lin and Hwang, 1992)”.

The taxonomies for use in HRA are as followings (Kim and Jung, 2003):

- Quantification of HEP: SLIM (Embrey, 1984), PLG-SLIM (Chu, Musicki, Yang, Kohut, Bozoki, Hsu, Diamond, et al., 1994), INTENT (Gertman et al., 1992), STAHR (Phillips, Humphreys, Embrey and Selby, 1990), and HRMS (Kirwan, 1997)
- Analysis of errors of commission: Macwan's PIF taxonomy for errors of commission (Macwan and Mosleh, 1994), Julius' PIF taxonomy for errors of commission (Julius, Jorgenson, Parry and Mosleh, 1995), and ATHEANA (US NRC, 2000)
- Overall context assessment and error analysis: HRMS, CREAM (Hollnagel, 1998 and Hollnagel, Kaarstad and Lee, 1999), and INCORECT (Kontogiannis, 1997)
- Database for HRA: Taylor-Adams' PSF taxonomy for CORE-DATA (Taylor-Adams, 1995), and Rogers' PSF taxonomy for CORE-DATA (Gibson, Basra & Kirwan, 1998).

Most of the PIFs listed in following list (Glendon, Clarke and McKenna, 2006):

Internal PIFs

- Emotional state
- Intelligence
- Motivation/attitude
- Perceptual abilities
- Physical condition
- Sex differences
- Skill level
- Social factors
- Strength / endurance
- Stress level
- Task knowledge
- Training/experience

External PIFs

- Inadequate workspace and layout
- Poor environmental conditions
- Inadequate design
- Inadequate training and job aids
- Poor supervision

According to the Millar and Swain (1987), PIFs include any factor that can influence human performance. PIFs may relate to the individual or external (see Fig. 4.), corresponding to the environment. External factors are considered to have greater impact. Most of the PIFs listed in following fig. (Glendon et al, 2006:151)

New full-set RSFs/RIFs taxonomy has been based on Performance Influencing /Shaping Factors (PIF /PSF) of Miller and Swain (1987) and Ya-Lih Lin and Sheue-Ling Hwang (1992). These are the most appropriate taxonomy when compared to others for new systematic approach of the HFRM model.

All the factors researched and collected from the above-mentioned sources are collected into a new full-set RIF/RSF taxonomy. After that, we omitted RIF/RSF items that had little relevance to human risks. Alternatively, items that were determined to have a bearing on human factors were included. Items involving the stressor factors were also removed because it was difficult to calculate risk score from the approach of human risk factors. These factors affecting and influencing the human performance in business management can be classified into two main groups; external and internal risk shaping/influencing factors (RSFs /RIFs). At last two main, four sub group categories and 45 items were determined. New full-set RSFs/RIFs taxonomy items and categories are determined as following:

Risk Shaping/ Influencing Factors (RSFs/ RIFs)**A External Factors****i Situational characteristics:**

- Organizational structure
- Organizational culture
- Politic environment and conditions
- Company life cycle
- System, policy and procedures
- Rewards and benefits
- Tone of the top and shareholder's expectations (company owner, board of the directors, etc.)
- External environment forces (external audit, requirements about corporate social responsibility, sustainable development, etc.)
- Organizational targets
- Audit and internal control systems
- Workplace environment

ii Task and Group Characteristics:

- Communication and coordination
- Feedback (knowledge of results)
- Intra and inter-group conflict and cohesion
- Decision making
- Others

B Internal Factors**i Characteristics of people resulting from internal and other influences:**

- Training
- Experience

- Knowledge and skills
 - Past-self efficacy
 - Current-self efficacy
 - Verbal and written communication skills
 - Task knowledge
 - Social factors
 - Threats (of failure, lost of job)
- ii *Characteristics of people resulting from external influences;*
- Job satisfaction
 - Personality and intelligence variables
 - Achievement motivation and attitude
 - Emotional state
 - Attitudes based on influence of family and other outside person and agencies
 - Individual control
 - Ethical values
 - Loyalty
 - Timeliness
 - Personal management skills
 - Social responsibility
 - Reliability
 - Risk taking and confidence
 - Past behavioral performance
 - Current behavioral performance
 - Creativity
 - Comprehensive and integrative thinking
 - Strength / endurance
 - Analytical and problem solving skills
 - Response to crises and seize opportunities on timely basis
 - Physical/health condition
 - Stress level
 - Perceptual abilities
 - Sex differences

After that new full-set RIF/RSF taxonomy, the Analytical Hierarchy Process weights the impact score of the human factor. Weighted results are used in calculation of total score: Likelihood <multiplied by> impact. Corporate high-level managers and human resources managers or selective jury members are responsible in this process. They report to present company management according to the score formula results.

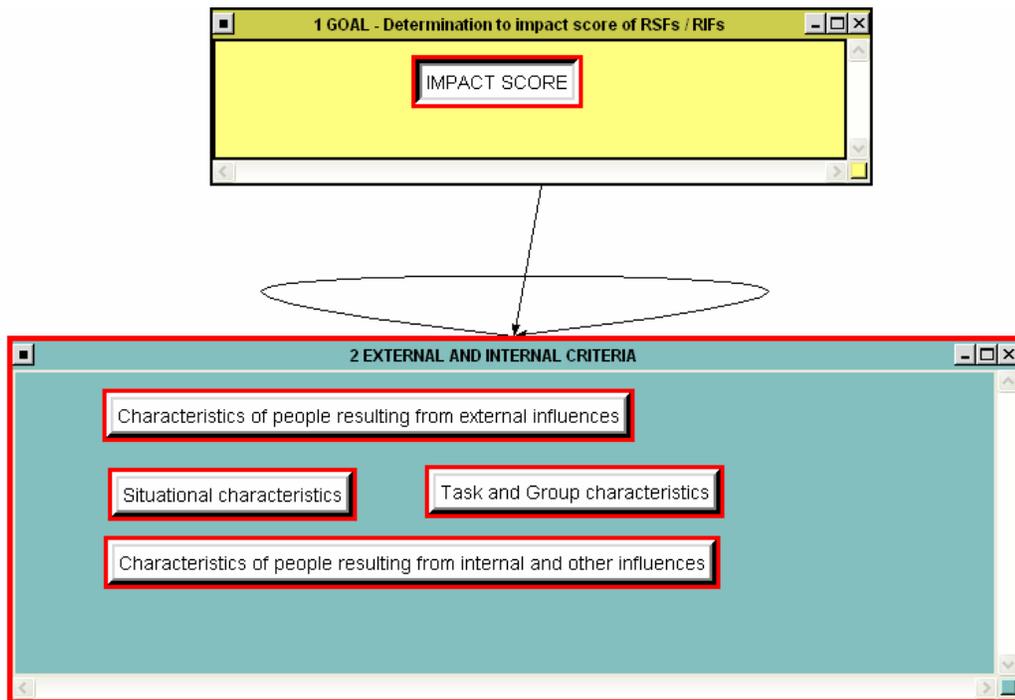
Managing human factor based risks is vital for both corporate risk management and sustainability success. It involves all positive and negative aspects of human nature including competition, skill, motivation, loyalty, and revenge, and is noted for its deliberateness. From the point of view of risk management these are all in the domain of human factors as defined earlier (Thevendran and Mawdesley, 2004). Some key questions are determined in the development process of RSFs/RIFs taxonomy:

- What human based risks will the organization not accept? (e.g. fraud, non-ethical behaviors, etc)
- What human based risks will the organization take on as new initiatives? (*e.g. innovation*)
- What risks will the organization accept for competing objectives?(*e.g. creativity and non conformity*)

Impact levels of RSFs/RIFs are ranked by Saaty's Analytic Hierarchy Process (see fig. 4.). The application of the AHP is based on the following four principles (Saaty, 1994):

1. *Decomposition*—A complex decision problem is decomposed into a hierarchy with each level consisting of a few manageable elements; each element is then further decomposed in a continuous fashion.
2. *Prioritization*—It involves pair wise comparisons of various elements residing at the same level with respect to an element from the upper level of the hierarchy.
3. *Synthesis*—The priorities, compiled through the principle of hierarchic composition, provide the overall assessment of the available alternatives.
4. *Sensitivity analysis*—The stability of the outcome is determined by testing the best choice against ‘what-if’ type of change in the priorities of the criteria.

Figure 4: RSF's / RIF's evaluation by AHP Model to human factor prioritization



The Analytical Hierarchy Process (AHP) provides a measure called the consistency ratio (CR) to check the consistency of judgment. Inconsistency is likely to occur when decision-makers make careless errors or exaggerated judgments during the process of pair wise comparisons. A consistency ratio of 0.1 is considered as the acceptable upper limit. If the consistency ratio is greater than 0.1 then the decision-makers have to re-evaluate their judgments in pair wise comparison matrix until the ratio is finally less than 0.1. In the AHP, the scale of absolute values of 1–9 is used for making the pair wise comparison judgments. AHP procedure is readily available in decision-making software packages from several commercial software sellers. In particular, these software tools make it possible to conduct a sensitivity analysis, which improves the effectiveness of the human factors of decisions reached through AHP. Analytical Hierarchy Process results show that internal factors are highly influenced and shaped by human risk factors (see fig. 5).

All of the RIF's factors are important to achieving organizational objectives and human performance. The Severity (Impact) factor scores will use to calculation risk likelihood as following:

Impact (Characteristics of people resulting from external influences) x 0.279604;

Impact (Characteristics of people resulting from internal and other influences) x 0.341707;

Impact (Situational characteristics) x 0.252634 Impact (Task and Group characteristics) x 0.126055.

Figure 5: Impact score results by AHP program.

Impact score of RSFs / RIFs

Icon	Name		Normalized by Cluster	Limiting
No Icon	IMPACT SCORE		0.00000	0.000000
No Icon	Characteristics of people resulting from external ~		0.27960	0.279604
No Icon	Characteristics of people resulting from internal ~		0.34171	0.341707
No Icon	Situational characteristics		0.25263	0.252634
No Icon	Task and Group characteristics		0.12606	0.126055

Managers can use this formula in their human resource performance analysis. This is a risk analysis applied to current personnel in the company. Risk score is calculated for every member of personnel in the company. Risk management team members, human resource management members or selective jury members in the company assign threshold values. As an example, if the average score assigned is 50 and one member of personnel has a 57 risk score, the required actions would be determined as a decrease of risk score of that member of personnel. Related activities may include education and training as means of performance improvement.

The calculation of the risk score includes internal and external factors. RIFs/RSFs and score formulas can use personnel performance assessments in the company. For this reason this model provides for a systematic approach and risk score formula as a supporting tool to human resources and its performance management.

This formula and its result have great applicability and importance in assessing human resources in a company in terms of current performance situations. High scores achieved mean that employees provide advantages to a company. If an employee achieves a low score, this person should improve in terms of their job related activities such as (depending on the applicability to the company) sales performance, training, marketing skills, human relationships, etc. Personnel empowerment should be one of the required fields.

Human Factor Score Formula and its elements as following:

i). Likelihood scale:

$$L = \{0 < L < 1\}$$

Likelihood calculation is included favorizing conditions, adverse conditions and uncertainty in this formula. Managers to the calculation of the likelihood should consider these.

ii). Impact scale:

$$I = \{0 < I < 100\}$$

iii). Internal Factors

Characteristics of people resulting from internal and other influences:
$$I_f = \frac{\sum_{i=1}^n I_{fi} \times L_{I_{fi}}}{n} \times 0.34$$

$E_f =$ Characteristics of people resulting from external influences:
$$E_f = \frac{\sum_{i=1}^n E_{fi} \times L_{E_{fi}}}{n} \times 0.28$$

iv). External factors

Situational characteristics:
$$S_f = \frac{\sum_{i=1}^n S_{fi} \times L_{S_{fi}}}{n} \times 0.25$$

$$\text{Task and Group characteristics: } T_f = \frac{\sum_{i=1}^n T_{fi} \times L_{T_{fi}}}{n} \times 0.13$$

v). **Total Risk Score: $R = I_f + E_f + S_f + T_f$**

Calculated rounded weighted rates of Impact by Analytic Hierarchy Process are:

To characteristics of people resulting from internal and other influences is = 0,34

To characteristics of people resulting from external influences is = 0,28

To Situational characteristics is = 0,25

To Task and Group characteristics is = 0,13

If the results of the score calculation are analyzed in detail, the strengths and weaknesses of personnel can be seen clearly and understood by the management of a company that employs this system. This can create the opportunity to reinforce the evaluated personnel's strengths. Managers can then work on optimizing personnel capabilities and they can derive maximum benefit from personnel capabilities and skills. The most fundamental contribution of the HFM model is the effective management of human based threats and opportunities towards achieving corporate objectives. Thus, human based threats can be minimized and human based opportunities can be maximized. Therefore, a company can be provided with reasonable assurance towards organizational and strategic objectives linked to corporate sustainability.

Score results will show existing gaps between current and desired state of human resources in the company. Managers can get an accurate picture of corporate human resource states by HFRM model. In addition, it can be useful with the following HR tasks:

1. Identifying critical human resource issues. Specifically those issues, which have a key impact on the delivery of company's business strategy.
2. Prioritizing critical human resource issues.

3.1.3. Step 3. Decision making to optimum handling of human factor

- Assumption
- Transfer
- Avoidance
- Risk mitigation

Decision-making and handling options involve identifying options for addressing or controlling human factor based risks, reducing the likelihood of an adverse occurrence, or maximizing organizational opportunities. Handling should also aim to enhance positive outcomes. Often, it is neither possible nor cost-effective to implement all treatment strategies. A business owner should aim to choose, prioritize, and implement the most appropriate combination of human factor based risk treatments.

3.1.4. Step 4. Assessment of the Human Factor Risk Management -HFRM system performance

Assessment of the Human Factor Risk Management system performance provides a qualitative measure of management based on predefined "targets" or "benchmarks" that HFRM efforts should aim to achieve. The purpose of this step is to:

1. Measure HFRM performance and assessment HFRM level in terms of ease of use
2. Identify strengths and weaknesses of the HFRM model
3. Target improvements
4. Report to senior management
5. Follow progress over time

3.1.5. Step 5. Improvement of the Human Factor Risk Management -HFRM system according to the developments and changes

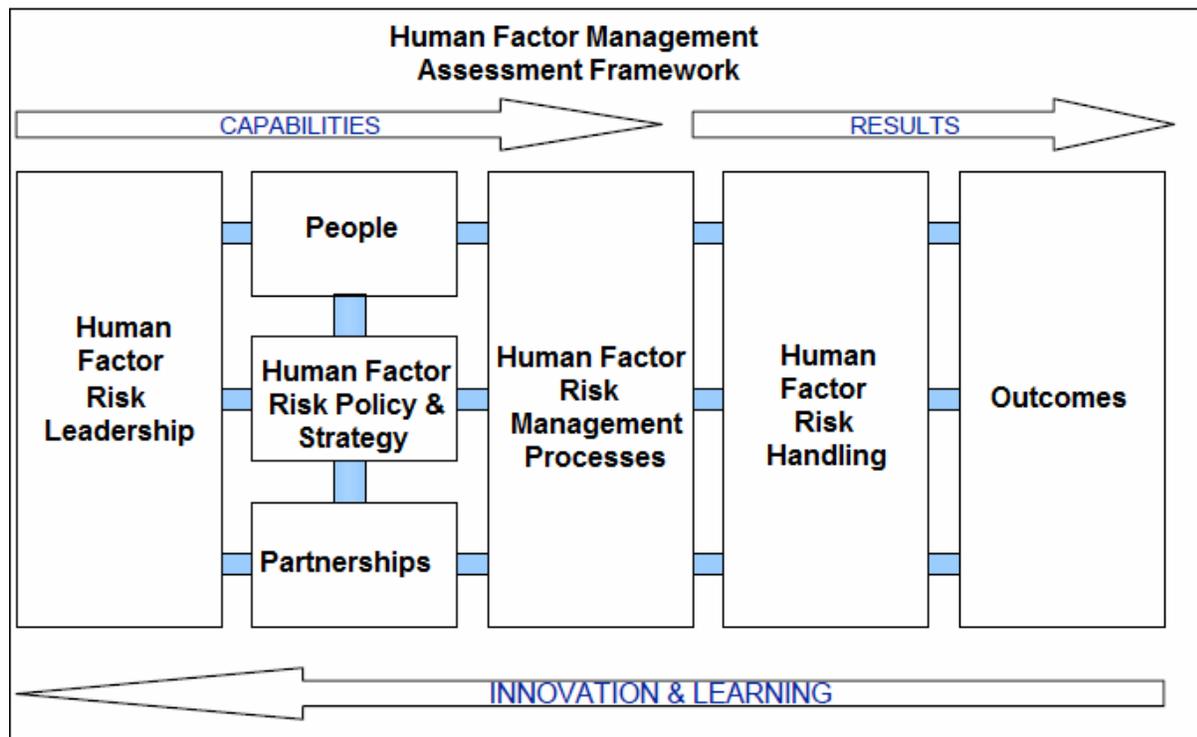
The purpose of this step is to ensure that the HFRM model supports the changing needs of organization.

Human Factor Risk Management improvement is a necessary step to understand the maturity of HFM practices within the company based on the following improvement actions:

1. Basic assessment: Is the HFRM model generally meeting basic internal and external stakeholder HFRM expectations as well as organizational requirements?
2. Mature assessment: Are activities and techniques employed for enhanced stakeholder confidence being managed effectively by HFRM model?
3. Advanced assessment: Is the HFRM model seen as a strategic tool to help enhance performance as a core value of the company?

“Advanced” is not to be taken as the desired target position. The target should reflect Management’s view on what is critical to future success in managing human factor based risks and the benefits it wants to achieve (KPMG, 2008).

Figure 6: Human Factor Management Assessment Framework (Adopted from Risk Support Team, HM Treasury, 2003, Risk Management Assessment Framework, Version 1.0, p.3)



The framework can be summarized using seven key questions (Adopted from Audit Committee, 2007, p. 1)

- i Human Factor leadership: Does senior management support and promote human factor risk management?
- ii Is there a clear HFRM policy and strategy?
- iii Are people equipped to manage human factor based risk well?
- iv Are there effective arrangements for managing human factor based risks with partners?
- v Do the company’s processes incorporate effective human factor management?
- vi Are human factor based risks handled well?
- vii Does HFRM contribute to achieving outcomes?

The Framework (see fig. 6.) has its genesis in the EFQM excellence model. Here it has been simplified and targeted to provide a flexible tool to assist HFM managers in evaluating their performance and progress in improving their HFM capability and its impact on improved human factor based risk handling and performance outcomes (Risk Support Team, 2003, p.2). The purpose of monitoring and review is to assess the effectiveness of improvement measures and also to affirm the 'health' of the HFRM system. It can serve as a control system. If similar risks continue to reoccur through the loop, then improvement measures may be inadequate. Similarly, if incident risks were not predicted, detection methods may need review (Raggrett, 2006). In addition, ethical, cultural and stakeholder expectations are integral to the HFM implementation process. HFRM is not one time static event. It is a dynamic, never ending, and continuous process.

4. Summary and Concluding Remarks

In this study, we have offered a new Human Factor Risk Management (HFRM) model. We developed a fresh full-set of human factor based risk shaping/influencing factors (RSFs/RIFs) taxonomy for use in the Human Factor Risk Management process. We calculated the impact weighting of the obtained RSFs/RIFs items that we evaluated through an analytical hierarchy process (AHP) technique. Impact weighted scores were used in scoring formula to prioritization of human factor based risks. The proposed full-set RSFs/RIFs taxonomy and score formula is used in new Human Factor Management (HFM) model. An appropriate analysis/assessment framework must be developed in order to use the taxonomy in other human resource areas. This paper presents a model for managing human factors via a well grounded, proactive, and systematic process based approach. The HFRM model is a very helpful tool for HR executives in assessing and managing their human resources; therefore, his model is offered as managerial tool. Likelihood and impact elements of new formula may improve employee performance. An effective HFRM model can provide a sustainable competitive advantage, critical to the success of any enterprise.

This research is aimed to contribute corporate risk management, human factors field and human resource management. Since the processes of the model are capable of dealing with all kinds of feedback and dependence when modeling a complex decision environment, we advocate that this HFRM model, full-set RSF/RIF taxonomy and formula are useful and workable. The HFRM model deals with complexity of human factors and provides insights to managing human factor based risks. The study of the RSF and the score formula developed are still in the process of investigation. Many problems still remain from the vantage point of human factors. Further research plans should include the examination and detailing of results obtained in this study as well as making more concrete recommendations that can be applicable in the work environment, which can point to improvements.

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