How can we shape our safety destiny – building capability and taking the pulse

A thesis submitted as partial fulfillment of the requirements for the degree of
Doctor of Philosophy

by

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Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

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Patrick S.K. Poon

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Abbreviations

ALARP: As Low As Reasonably Practicable
APIL: Association of Personal Injury Lawyers, UK
BS: British Standard
BSI: British Standards Institution
EC: European Council
EIO: Externally imposed obligation
EMS: Environmental Management System
EPSC: European Process Safety Centre
GSC: Goal-setting Capability
HEL: Health and Safety Laboratory, UK
HES: Health and Safety Executive, UK
ibid: in the same work
ISO: International Organization for Standardization
LTIFR: Loss time injury frequency rates
NOHSC: National Occupational Health and Safety Council
OAC: Operation and Administration Capability
OHSMS: Occupational Health & Safety Management System
POA: Level of Proactiveness – Operation & Administration
PRC: Level of Proactiveness – Risk Communication
PRM: Level of Proactiveness – Risk Management
PST: Level of Proactiveness – Safety Training
RCC: Risk Communication Capability
RMS: Risk Management Capability
SARS: Severe Acute Respiratory Syndrome
SCD: Strategic Capability Development
SCT: Social Cognitive Theory
SCMM: Safety Capability Maturity Model
SMES: Safety Management Efficacy Scale
SMS: Safety Management System
SPI: Safety Proactiveness Index
STC: Safety Training Capability
TQM: Total Quality Management
WHO: World Health Organization
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Abstract

How do we shape our safety destiny? It is within the limits of our own making, that is, our capability. But, how do we know it is on the right track? In other words, how do we take the pulse? These questions set the context and scope of the research in which a number of key issues related to capability building and evaluation were addressed.

In recent years, the approach of capability development has been widely researched by economists, organizational psychologists and management theorists. Unfortunately, because of its complex nature, the assessment of capability in professional context has not been properly addressed in the literature. The problem is two-fold. First, is criticality, or more accurately the lack of understanding about what capabilities are critical to our future success. The second one is concerned with the evaluative aspects of capability development. Using safety management as a study platform, this research introduced a contingency model of “strategic capability development” (SCD) as a plausible alternative to some of the well-established approaches, for example, the one advocated by Amartya Sen. To address the evaluation issues, an innovative method for assessing capability maturity was constructed. The key variables were based on people’s proactiveness and their self-efficacy beliefs.

Through meta-analysis, a set of critical capabilities or indicators was identified and used as the key variables for designing the survey instrument, that is, the Safety Management Efficacy Scale (SMES). These variables included goal-setting, risk management, safety training, risk communication, and operation/administration capabilities. Hypotheses regarding the interactive effects of each of these critical capabilities were then derived and tested. The results suggest that a high degree of coherency among the key variables does exit. There is a positive and significant association between critical capabilities and goal-setting capability. The positive effects of risk management capability on safety proactiveness are strong. However, in regards to how goal-setting capability influences proactiveness, no conclusion can be drawn.

Having taking the pulse, the capability maturity profile of the safety profession is examined. As it is turned out, the proposed SCD framework and SMES instrument together provide a point of departure for conducting similar research, including but not limited to human resources development, people capability maturity assessment, training/curriculum development, and performance evaluation.
**Episode**

This learning journey started when Nicolas, one of my friends, asked me for help with a management problem concerning safety. He had been moved sideways at executive level in his organization (a form of job rotation I guess) and became responsible for corporate risk management governance and strategic development. Over lunch he said, "I need to realign our organizational capabilities because of business expansion and job rotation. Tell me something about capability development."

To this intriguing question, I gave him everything I knew at that time in one word, "Huh!"

As time went by, I began to realize more and more about how one essential capability leads to another. One of the results, stemming from this capability study, was a series of capability-based safety training programs. Each one is self contained and intended for individuals or groups within any organization that wants to optimize performance, for example, in dealing with safety management issues in the workplace. The philosophy behind is a bundle of things that can be generalized to suit a wide range of applications – management, human resource development, strategic capability planning, safety or risk management, … etc.

I got back to Nicolas to give him the answer, looking like a recipe. But, he asked: “How long will it take?”

I said there should be improvements 'felt' rather soon, and measurable shortly after. From then, it becomes a perpetual process. It becomes a strategic skill when the organization understands the need for constant attention and improvement in its critical capabilities as well as individual competencies. Fortunately, all the expertise that will be needed will be found and developed within the organization, meaning that extensive use of costly 'experts' could be avoidable.

“What you said sounds interesting and challenging!” said Nicolas. “Still, there are problems! What the hell are critical capabilities?” And, “How can we measure them, for example the level of capability maturity?”

Apparently, there were no immediate answers to these capability issues but really they are the challenges for my learning journey.
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Chapter 1: Introduction

1.1 Overview

My thesis revolves around two main areas of academic interest: capability development and evaluative aspect of the capability approach. There is an accent on safety management, a discipline that I have been pursuing in the last 12 years as a course developer in areas of occupational safety and health as well as a leading consultant of a safety research and consultant group.

The two areas of interest inform each other. In the first one, the concept of capability building, human functioning and state of well-being are informed by the work of Amartya Sen\(^1\), while ‘capability building and development’ attempts to bridge the gap divided by a fragmented but rigid rule-based thinking of some practitioners. In the second area, I draw on Albert Bandura’s Social Learning Theory, in particular his “self-efficacy belief” approach, to develop a research instrument for assessing safety management capability.

My thesis reflects the influence of these writers. Through the lens of Sen’s *Capability Approach* (Sen, 1993) and Bandura’s *Social Learning Theory* (Bandura 1986, 1997, 1997a), the research seeks to underlie and argue the importance of capability building against the current “one size fits all” safety management approach. Central to this study is the development of a contingency model and an evaluation instrument for guiding safety efforts and assessing the managerial capability of safety practitioners. This is the first expanded treatment of Sen and Bandura’s theories for examining management issues beyond their normal scope of application.

The motivation to this study in ‘capability building and development’ (using safety management as a backdrop) was strongly shaped by contemporary professional considerations and by what it means to be critical, strategic and professionally capable. Besides making reference to the work of Sen and Bandura, the deepest influences upon my thinking and writing include Donald Schön, Chris Argyris and Peter Senge. These contemporary theorists and

management gurus teach us how to think or philosophize in the postmodern condition, in an age when the meta-narratives have lost their legitimating power. They provide a positive philosophical or theoretical response to the fragmentation and dissolution of our professional life. Schön, Argyris and Senge adopt many different literary forms, sometimes within the same work. Their investigation is at once dialogical, confessional and, most of the time, their work involves understanding of human beings and how one thing leads to another. For these great thinkers, the question of the style and influence of their philosophy or theory is paramount. In my view, it would be productive to approach their philosophies in a different way – as a kind of practitioner’s research.

1.2 Setting the context

Safety is undoubtedly one of the most intractable and contested issues of the public agenda. It is a world-wide issue. In Hong Kong, the recent introduction of safety management regulations has given rise to some confusion in complying by stakeholders. The approach of which is self-regulatory rather than prescriptive. The legislation suggests a certain degree of compliance which refers to a range of rules, codes of practice, control measures, safety standards and management principles (e.g. plan-do-check-act) that government expects industries to comply with. It is believed that effective self-regulation allows industry to be more responsive to changing safety needs. It is also believed that self-regulatory safety management schemes tend to promote good safety practices and target specific safety problems within industries. However, self-regulation is clearly not the answer to every safety failure or able to meet all safety management objectives. To enable effective implementation of what is required by law, a condition of capability building and development is needed on the upfront. Unfortunately, a proper treatment of capability issues and related research is seriously absent.

The issues being dealt with in this thesis were decided upon as a result of my personal experience with a range of key safety management issues. These issues are outlined below to provide the reader with an understanding of the departure point of this thesis. First of all, I was curious as to why the general discussion of safety management issues seems so focussed on the problems of system, legislation compliance, behaviour and culture rather than people capacity. The general trend of investigation and debate about safety management issues, left the potential of human capability development relatively untouched. For instance, the arguments advocating the integration of safety management with other organizational functions seems to be centred more around a system approach for the sake of organizational effectiveness without considering staff capability and strategic development needs.
Secondly, the adequacy of the overall service capability level of the safety profession is in serious doubt. Traditional workforce in occupational safety and health (OSH) make up a very tiny fraction of industry while risk exists everywhere. Risk and its possible consequences are undesirable but safety is not. Risk is something terrible to ignore. It could be trivial initially but it may lead to tragic consequences. The capability to deal with the ever-increasing safety problems in the workplace is therefore a somber and critical resource issue. Unfortunately, a large number of reluctant ‘followers’ tend to stick to the law or the rules (Veltri, 1991) at bare minimum operation level and tend to adopt an option of following or simply complying with the legal requirements rather than treating workplace safety in a proactive, positive manner.

Thirdly, safety benefits are often undermined by organizations that value immediate financial profits rather than the intangible benefits brought about by self-regulatory safety management. It is because safety well-being can only be achieved by long-term strategy but not easily measurable.

What is at the root of the above problems? Safety in criticality is a systemic problem - a reflection of conflicting goals. Lack of attention to the well-being of workers is not uncommon but unchallenged. People see survival and profitability of an organization as their primary concerns. This kind of thinking inherent with ‘capitalism’ is infused in all cultures, leaving ‘unprofitable activities’ like safety and related capability development issues to hang around the workplace with undue attention paid.

1.3 Background of study

In today's social-conscious world, companies and organizations are held increasingly accountable not only for their financial performance, but also for the impacts that their operations have on the workforce and the environment. Workers safety is a critical issue that affects an organization’s reputation and performance. Yet organizations are still struggling with reducing the number of accidents/injuries in the workplace without understanding much about the rationale. In the meantime, many of us do not see how to capitalize our human resource to cater for the additional need arising from safety and loss control programs.

Here in Hong Kong, the last two decades of economic growth and reform have led to a booming economy. At the same time the growth has been accompanied by the emergence of serious safety problems and an increasing number of work related incidents, injuries and illnesses. We can see very little evidence that there is a coherent development process or a logical mechanism through which to determine priorities and strategic options, especially in Hong Kong where safety management does not have a long history.
In other countries, such as the United States, NIOSH studies clearly show there was no correlation between “traditional safety elements” and accident rates (Hansen, 1993). In fact, it was found that some of the critical elements (e.g. safety personnel and committees) actually have strong correlations with poor safety performance. What we’ve learnt from these studies is that we are not quite sure what are the priorities and, in essence, the need for prioritizing our safety goals and objectives are largely ignored. Here we are facing a dilemma of confusing ourselves with priorities if we do not think through what we are about to do or what we are supposed to be capable of doing. Effectiveness of safety management would seem to be dangling in the air if we do not have any particular position or strategy at all.

A laissez-faire attitude towards safety has built up over the decades in some organizations. Implementation is problematic and the effectiveness of which is a critical issue to be dealt with. One of the major problems is the difficulty by which personal goals can be aligned with the organizational objectives (Rahimi, 1995). Some fail to address safety needs in actual practice and very few understand their social and ethical obligations instead of undertaking safety as just another legal mandate that they have to comply.

Impact of new practices

The way work is being done is changing rapidly, especially in highly industrial countries. What should workforce development strategies address? A growing literature has recently been devoted to the impact of new technologies organizational practices upon productivity and labor demand (see Arnal et al. 2001 for a review). The so-called new organizational practices include TQM, just-in-time, innovation and creativity or customer-oriented strategies, performance management, etc. The findings support the view that there exists little statistical evidence on the potential impact of new organizational practices upon the improvement of working conditions. In a number of European countries, working conditions and health and safety at work have worsened in recent years (see Green & McIntosh 2002).

According to the European Survey on Working Conditions conducted by the European Foundation, work intensity has increased during the past decade (Merlié & Paoli 2001). Despite the continuous decline of the manufacturing sector, the share of workers working at very high speed reached 56% in 2000 as compared to 48% in 1990. At the same time, an increasing proportion of workers report work-related safety and health problems. Despite this upward trend in work related safety and health problems, it is only until recently little interest had been devoted to the consequences of the new forms of work organization on well-being at work (Merlié & Paoli 2001).
At present, safety suffers from an ad hoc approach that takes too long to generate the necessary capability to deal with the emerging issues. But, new technologies and new practices offer no overarching model through which to map current capabilities against immediate and future demands because of rapid technological changes. This weakness is partially the nature of the work, which left organizations with no comprehensive means to address long-term safety capability development needs.

The ‘boiled frog’ syndrome

The way in which attention to safety evolves is full of change and challenges. Today’s safety climate can be traced back before the passage of the Occupational Safety and Health Act of 1970 in the United States to early studies of toxicology and risk of industrial chemicals to human health. Public concern on safety has had an increased impact on many organizations in recent years. Bottomley (1999) rightly points out that “while there is agreement about the elements required in an effective system, particularly the need for active management and employee involvement, there are a number of emerging issues casting doubt about the relevance of OHSMS as currently constitute.” (p. ix)

Catalyzed by the nuclear disaster at the Three Mile Island (28 March, 1977), the Bhopal-Union Carbide disaster (3 December, 1984) in which more than 2,000 killed, the Chernobyl nuclear power accident (25 April, 1986), the Challenger accident (28 January, 1986), the Piper Alpha Oil Rig disaster (6 July 1988), these unsatisfactory states have been brought on by a growing pressure and public perception that organizations and enterprises should take on board safety issues with a self-regulatory management approach. Because of these industrial disasters and tragedies, businesses and industry are coming under increased pressure to demonstrate that they are dealing with safety issues in proactive, sustainable ways commensurate to the risks involved in their situation. In dealing with anticipated risk, a more proactive approach is entailed.

Have people ever learned from these disastrous but intriguing lessons? No, not quite! Albeit under increased public pressure, safety is however a word that is sometimes misused. Very few really understand exactly what "safety" really means. In organizational context, it is commonly used to explain goal attainment and measure safety performance, most of these interpretations are from a traditional management point of view. Unfortunately, safety is seldom taken seriously enough to become an organizational learning issue.

According to Peter Senge (1990), even the most successful companies with very bright and committed people can’t reach their full potential because many of them are poor learners. He

\[2 \text{OHSMS: Occupational Health & Safety Management System.}\]
It is no accident that most organizations learn poorly. The way that they are designed and managed, the way people's jobs are defined, and, most importantly, the way we have all been taught to think and interact create fundamental learning disabilities” (ibid:18). Ironically, Peter Senge states: "All too often, proactiveness is reactiveness in disguise" (ibid:21). Sometimes being "proactive" creates more problems than it solves. Proactiveness often refers to "taking action" over analyzing the situation thoroughly. Safety is no exception. I think it is no accident that most people learn poorly in matters of safety and health because of their misconception and confusion in understanding what risk and safety really mean. The flaws arise from inbuilt belief systems rather than ineffective practices or poor planning.

Many of us know the ‘parable of the boiled frog’. It is a story that helps us to understand the key safety challenge in dealing with risk and rapid change. Senge (1990) uses the extended metaphor to explain further that a frog will quickly jump out of the water if it is too hot to live in. But if you put a frog in water under normal temperature and heat it slowly, the frog will stay in. The frog will stay in the water until it is no longer able to escape from its miserable fate. The situation becomes too late even though the frog finds out that the situation has become dangerous for it to stay. "Why? Because the frog's internal apparatus for sensing threats to survival is geared to sudden changes in his environment, not to slow, gradual changes" (ibid: 22). It is often so true in life that we cannot easily identify threats and slow changes over long periods of time, as we can with immediate threats or undesirable events with visible or predictable outcomes.

**Passive compliance culture**

The lessons that we learn from Peter Senge (1990), in particular the parable of the boiled frog, explain why safety passivity overshadows proactiveness in most cases.

The idea of conformance pervades all cultures. In the last two decades traditional safety programs are improved gradually but with growing complexity. They are typical of what exist in most workplaces today. Programs like that include designated safety personnel, safety and health committees, safety rules and procedures, etc. These management strategies place special emphasis on safety responsibilities with safety staff but fail to make safety as an integral part the line operation. The basic principle that “those who create risks from work activity are responsible for protecting workers, the public and the environment from the consequences,” (Williams, 2002) is largely ignored. Furthermore, people often regard safety management as a
kind of non-productive activity, and the adoption of a safety management system (SMS) is often regarded as a mandate required by law rather than a strategic management function to deal with moral, social or ethical obligations.

A general passivity is observed. Organizations are pretty much committed to safety but on a compliance basis. Hansen (1993) sums up the findings of Anthony Veltri’s survey and summarizes that most organizations are “reluctant compliers” who primarily focus on regulatory compliance in a passive, reactive way.

“The safety function’s job is to insulate the rest of the organization from compliance problems.” Some are “followers” (16%) “… who employs creative technical approaches and frequently employs ideas and program developed by others”. Very few are “leaders” (7%) “… who employs truly progress ideas and approaches. Their programs add strategic value and build technical capabilities within their organizations. Being leaders, they do things significantly better than others in their industry.” (Veltri 1991).

In essence, the flaw of this compliance culture is a general lack of commitment due to inadequate understanding of the approach, problems and, in a wider context, the social and ethical obligations.

**Need for job enrichment and capability development**

One of the most important functions of the safety professional as defined by the American Society of Safety Engineers is dealing with the development of loss control methods, procedures and programs. Central to this function is the idea that we should develop integrated programs that demonstrate the relation of safety performance to the primary function of the organization.

A number of safety professionals believe that the total effectiveness of safety programs today is seriously reduced by an *inability to effectively relate safety objectives to corporate goals*. Too often safety professionals still only ask for “management support”. Too often they are in this ineffective position because they have not demonstrated to management that safety is controllable by training, job enrichment, planning, organization, and management direction. They are not using the well-developed tools to quantify the safety objectives; they are not relating safety goals to overall management objectives; they are not coping with organization resources in safety; and they are not making any attempt in optimizing or developing the limited human resources in the organization, for example, “job enrichment” in Herzberg’s language, or “capability approach” according to Amartya Sen (Herzberg, 1968; Sen, 1993).

**Social responsibility and legal obligation**

The very idea of managing safety at work was lost in the focus of our times, which is *largely on an emergency and ad hoc basis*. Of course MBA programs (e.g. the ones in Hong Kong) have
not given the right attention to risk/safety concepts and thus we cannot expect managers to function well in dealing with risk issues related to safety in our workplace.

To a large extent, the safety responsibility is discharged by those who are employed according to what is required by law (e.g. Safety Officers). The central theme of 'safety management' was lost and sometimes misleading because the requirement is often considered by many as *externally-imposed rather than based on internal needs*. The general practice of today is grossly described as ‘conformance’ rather than ‘atomic’ in its primary purpose.

In response to the Health and Safety Executive (HSE) consultation by the Association of Personal Injury Lawyers (APIL) in the U.K., APIL states firmly in their comments on HSE’s strategic thinking that:

> “Safety law exists to protect both workers and members of the public from death and injury. Every breach of it should be taken seriously. Dealing with breaches proportionately equates, in our view, to tolerating breaches and this cannot be acceptable. If health and safety in the workplace is to be improved, employers must be aware that consequences will follow a failure to comply with the relevant legislation” -- APIL (2003: 4)

The legal obligations and consequences are clear according to APIL (2003). However, when an issue is taken as externally imposed and the problems do not seem to be that pressing, who then would really care? It is a kind of “Boiled Frog” syndrome. When accidents occur, people treat usually just the symptoms and NOT the underlying cause. Management focus on the implications of externally-imposed ethical obligations appears to have blinded people to become a passive follower – the only action is to react to events. The idea of self-regulatory safety management has become a silent ‘S’ right behind a long list of business strategic goals although we can often see the slogan, “Safety First”.

Nevertheless, the problem of safety is inherent in what we are doing. It is part of our work. It is something concerned with strategic management, a managerial function that helps organizations identify, analyze, and respond to social and political concerns.

### 1.4 The old myths

#### Issues in local context

We in Hong Kong have a legislation of safety management which has just been put in place by the government since early 2002. Under this new safety management regulation (3), a proprietor

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or contractor of specified industries is required to develop, implement and maintain a safety management system, consisting of a specified set of key process elements. It is just a start, clouded with uncertainties, rising from the foothills, speculating by many but very few understand where it will go. To comply, to follow or to lead? We are uncertain as to what should it value, what should it accomplish, how exactly we should describe the system evolving from the regulation, and how do we move past the known and familiar to the unknown reign – to manage risk and uncertainly for the common good.

On the positive side, introduction of the new safety management regulation may help improve generally the standard of safety in Hong Kong. The wake of this social and ethical awareness, albeit its relative short history, do help organizations recognize the needs and benefits of our growing knowledge of hazards, hazard detection, production, medical treatment and tools for managing risks. We now have more and better educated safety professionals and practitioners than at any time in the past. Legislation dealing with the working environment has gradually been strengthened but there is also evidence of more proactive role on the part of government agencies, educators and employers.

On the down side, it is beyond dispute that workplace changes just described have also introduced new hazards or place some groups of workers at risk. For example, mechanization of the workplace may result in problems of work intensification, disorganization, noise, heat or cold, vibration, fumes and airborne contaminates. Recent legislative developments have been encouraging but not always enhanced safety performance and even improvements in standards have not always had a significant effect due to a lack of effective implementation. From what I have observed as a safety consultant in the past few years, the overall goals, priorities, strategies of organizations are generally lacking in coherence and sometimes they are out of balance. An attitude of compliance to the law is a common baseline.

An overall improvement will depend on a number of things, perhaps most critically the recognition by employers, manufacturers, designers, safety professionals and others of the need to integrate safety considerations into the change process. At present this appears to be occurring only in a very limited fashion.

**External legal and social Factors**

Because of the recent enactment of the self-regulatory safety management legislation in Hong Kong, organizations, the safety profession, individual safety practitioners, consultants, educational/training institutions and the like have become increasingly interested in improving safety performance as a way to demonstrate safety values, and improve outcomes. With increasing social attention, more stringent legislative requirements and growing business...
competition, one question to ask ourselves is, “In matters of safety and health, are we thriving or merely coping?”

Regulations enforced or promulgated by the government are, in general, designed to achieve social policy objectives. The central problem for the regulation of safety management is however that it is not possible to mandate this objective effectiveness since some employers are reluctant to follow or sometimes they fail to perceive their social responsibility to comply with such a legal requirement, especially when it involves substantial financial implications. In at least some cases the harm to workers is truly accidental and beyond the control of the employer. In many cases of workplace fatality, for example, it is difficult to establish any tangible employer culpability (APIL, 2003); and to hold employers strictly liable to the unfortunate consequences.

Beginning in the early 1980s, a new style of legislation stemming from the 1972 Robens Report in Britain was progressively enacted in many countries including Hong Kong in the early 2000s, and all other jurisdictions have very similar provisions. This supplemented the detailed descriptive rules by imposing a single overarching duty of care on employers. To provide just one example, by adopting a self-regulatory approach, the Hong Kong Safety Management Regulation requires an employer of designated high-risk industries “to ensure, so far as reasonably practicable, that the employee is, while at work, safe from injury and risks to health”, and under the Hong Kong Safety Ordinance the concept of ‘duty of care’ and its requirements are applied to all workplaces. This however gives rise to some confusion in interpreting the concepts of self-regulation, practicability and duty of care. On one hand, employers were supposed to work out for themselves what the general duty requirement meant in their particular case. On the other hand, where it is reasonably practicable for an employer to secure the safety of employees, and yet a worker is harmed, the employer can be presumed to be in some degree culpable.

**Internal systemic problems**

The Robens approach (1972), upon which the Hong Kong safety legislation has been based, has often been described as one of the self-regulation. The idea that employers are responsible for working out how to achieve a safe workplace is one aspect of this self-regulation. Since the introduction of the safety management regulation in 2002, the concept of self-regulatory safety management here in Hong Kong has also been the focus of considerable attention in the face of this new challenge.

In what sense is all of this self-regulation? There are varieties. Rees (1988) distinguishes three – total self-regulation, voluntary self-regulation, and partial self-regulation. No matter in what form the regulation is reinforced, there are at least three group of people for whom regulations can function as a resource - government officials, company safety officers and
managers, and worker safety representatives. In short, regulation is not simply something imposed on employers by the regulators. It has a lot of resource implications on all parties concerned.

For internal enforcement, the major problems lie in the ways by which a positive safety culture could be cultivated. However, with this understanding, how do we create a system in which well-informed, value-conscious organizations can use it to enhance their safety performance. Enhancing management effectiveness is on this side of the challenge. Accordingly, profit-making and creating a safe working environment are seen as mutually exclusive, assuming both are not possible. Many organization, however, have managed to transcend the “either/or” choices that have been taken for granted in the past.

What we have here is a systemic problem implicated by some form of resource constraints and human factors, as well as an enormous list of internal and external reasons for why this is so difficult to address the safety issues. For example:

(1) Production imperatives

Interviewing frontline managers of one of my clients prevailed that they've always got deadlines, budgets, resource limitations and real problems in addition to safety concerns although the slogan was: "Safety First!" The feeling was that their management was sending a double message - "My boss doesn't mean it about safety," and after all "We don't know how. We have too much to do already and we simply don't have time! In the real world it's flexibility that counts."

There is evidence that many injuries are caused by the pressure to restore normal production when for some reasons it has temporarily broken down. When construction work is under tight working schedule the pressure on workers to take shortcuts in order to get things doing are often inevitable and many injuries occur in these circumstances. Another production pressure which is often cited as a cause of accidents is the production bonus scheme which operates in many industries (Dwyer, 1983). Under certain conditions such systems can place great pressure on workers to engage in unsafe practices.

(2) The physical/technological environment

Physical/technological environment explanations are often used to account for the high accident rates in particular industries. In Hong Kong, the large number of accidents in construction operations, for example, was commonly attributed to the fact that people were working in a high-

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4 For more details about safety culture and the related studies, see Lee, 1998; Cox & Flin, 1998; Cheyne, Cox, Oliver & Tomas, 1998; Flin, Mearns, O'Connor & Bryden, 2000; Glendon & Stanton, 2000; Grote & Künzler, 2000; Glendon & Litherland, 2001; Guldenmund, 2000; Hale, 2000; Neal, Griffin & Hart, 2000; O'Toole, 2002; Wiegmann, et al., 2002; Mearns, et al., 2003.
risk environment. In North Sea drilling operations, for instance, many of the accidents was due to the fact that workers were working at the frontiers of technology and in adverse weather conditions (Carson, 1982: 5)

In order to reduce present and future technological threats to human safety health, we have to develop and introduce alternative approaches, which can overcome some of the weaknesses of end-of-pipe treatment solutions to safety problems and are more effective and efficient in reducing the likelihood of accident occurrences.

Choosing between explanations

The above explanations represent some of the systemic problems. To choose between these explanations, one strategy is to assume that for each accident one or other of the factors will predominate and some of the factors are more critical than the others. Based on the connection and integration of semantic and conceptual knowledge from different spheres of experience, I would argue that:

1. we need to understand the role of “risk” in safety language by asking ourselves the question: “How do risks come into being?”
2. we need to clarify our goals and redefine the definition of safety concepts, and think strategically if we are going to address how to build a safe and healthy organization capable of dealing with systemic safety problems and capable of dealing with risks in an effective way that allow us to enhance our working environment;
3. it would be more useful to attribute safety problems to a systemic, organizational or working environment rather than simply to attribute them to the characteristics and behaviour of workers alone; and
4. we need to re-conceptualize the way in which we deal with strategic issues to acknowledge that some form of measurable indicators is a necessary because there is insufficient knowledge about how effectiveness is properly defined “The challenge, however, is to find a way to highlight good management practice simply.” (Mansley, 2002: 11).

From a systemic point of view, the function of safety can be regarded as the characteristics that accompany safety and make it an emergent property of any system or operation – the function that makes safety fit into an organization and makes an organization fit with safety. Different social groups (governments, regulators, organizations, etc.) take advantage of this basic organizational property and social change that are most consistent with their interests, because safety redefines the contexts of what is primarily a basic organization or system function that
concerns with the well-being of people. In doing so, they adopt and use a number of different management strategies and practices.

Perhaps the most common strategy, particularly in safety discourse, is a passive conformance to legislative requirements - the claim that the legislative change advocated by governments might not be in full agreement with choices of organizations and thus is sometimes beyond management commitment and consequently beyond deliberation. Other specific strategies for influencing organizational discourse about effective safety management include risk identification, control and monitoring, training and development of personnel, as well as feedback and communication, especially those that emphasize productivity, speed, efficiency and urgency.

The above represents a truly unprecedented challenge. Our safety vision and efforts seem to have overcome uncertainties and changes over time. However, our scientific methods will need to be modified and enriched (Ravetz, 1997, 2004). Jerry Ravetz, in his paper to the Knowledge Base of Futures Studies (Ravetz, 2004), points out that the possibility for unexpected effects ramify beyond control as technology becomes more sophisticated in its manipulations of information.

By focusing on the paradoxical nature of the problem, this study is intended to contribute to this new learning process – an important part of which is to redefine safety concepts and to understand the importance of goal-setting, capability building and development, and strategic choice.

1.5 Need for a new myth

What is the moral of the story: “Parable of the Boiled Frog”? Don’t become a "boiled frog." Don't let unexpected change creep up on us. Don't suppose that things will just stay safe. Be always aware of what is going on around us. To be prepared for change, we need to be proactive and watch out for “temperature” change so that we can notice when the "water" is getting hot. Knowing far enough and being prepared allows us to make plans. Whether it is a paradigm change or acquiring essential safety management capabilities, we can be prepared when the time comes. Keep testing the water so we can escape before we get boiled. Gauging the “temperature” and knowing the change allows us to transform a threat into an opportunity rather than leaving things to chance.

An unfortunate accident or incident is only a snapshot of a much bigger picture or the tip of the iceberg. The rest of it is certainly more frightening to look it. An accident is only the latest in a series of freak incidents involving negligence and “learning disability” (Senge, 1990). It is
much harder to restore when we don't have that acute picture or when things end up with something which is sort of irrevocable disorder. Being *proactive* about managing safety means actively searching for and responding to what is likely to happen. It also means responding to our intuition because our instinct might provide appropriate warnings that help us resist falling into a rut of unexpected coincident surprises.

**Gauging the temperature and taking the pulse**

*Risk and danger* are the traditional terms, relating to safety experience which is gained in slow time. Therefore, don't become a "boiled frog." Gauge the temperature and take the pulse. “*In order to learn new ways of thinking, we must make a critical examination of the old*” (Ravetz, 2004: 8). “*The term ‘risk’, now controlled by official expertise, stands in the way of learning*” (ibid: 8). What is excluded, unfortunately, “*is all the complexity, social, ethical and conceptual, of the process whereby unwanted events first happen and are then managed.*” “The presuppositions of the authors, providing good evidence for the prevailing mindset, are displayed by the statement that the difficulties in the question, *‘is it safe?’* could be reduced if the public has some concept of scientific methods.” (ibid: 9). To further reduce the problem to a more basic level, it is a matter of “capability” and “human functioning” (Sen, 1993).

As the elements of uncertainty and ignorance in the study of workplace safety, risks, and hazards become greater, the more influential will be the prior methodological commitments and capability building. We have in fact been living with such a situation for decades. But not too many people challenge the validity of these ‘facts’ other than a scientific point of view.

**Capability development**

If we extend our view to the case where vision, goals, values, and uncertainties are considered important, then we need another form of safety practice and capability. We call this ‘post-normal science’ (Funtowicz & Ravetz,1994). In this case, we need a new understanding consisting of all those concerned with the emerging issues, local knowledge, and a new kind of competency and capability. And these must be able to offer the much needed evidence and learning opportunities, based on a different approach such as practitioner-based research. The kind of research which “is a crucial vehicle of learning, but not just any kind of research will do. Research [in management] needs to be timely, relevant and offer practical advice.” (Jocelyne Bourgon, President, Canadian Centre for Management Development, March 2004)

In a wider social context, it is about capability building and development, functioning and state of well-being (Sen, 1993). It is now generally accepted that attempts, which are
required to reduce complex and dynamic problems to their simple/practical dimensions, have to be resolved. These dimensions are identified in Chapter 4, Section 9.

It will be seen that in dealing with safety management issues, the participants in this research were faced with an ongoing need to create a new way or new perspective for their organization. In some ways this resembled dismantling old myths and showing the way to new myths. In considering this myth-breaking and myth-making, a capability development model based on Amartya Sen’s “Capability Approach” (Sen, 1993) has been arrived at and is introduced in Chapter 6.

Developing a new myth requires changing not just the organization, but also the way people see themselves and what they can do. Strategic management, goal-setting, management capability, functioning, state of “workplace well-being”, capability maturity and evaluative aspects of capability development are the key issues of the current study.

**Methodological issue - evaluative aspect**

Current methods of assessing safety management effectiveness are confusing. By its nature, a safety management system is designed to control risks and deliver desirable outcomes consistent with the safety goals. Nevertheless, methodological issues remain problematic, especially how performance is effectively measured. Bottomley, in his review of the strategic issues, he contended that:

“There are methodological issues that require statements about performance to be qualified. One of the key problems is the divide between measures of the system (process measures) and measures of the results of the system (outcomes). Methods to bring these together are recommended.” -- Bryan Bottomley (1999: x)

Audit or safety management review protocols do not differentiate between the two (process measures and outcomes). Many of these methods simply take the legislative requirements as a yardstick, almost clause by clause, without taking into consideration of the contextual factors such as size of the organization, the nature of business and level of risk involved. And as such, methods of assessment are sometime either over-constructed or under-designed. The idea of “one size fits all” may end up over-doing by having a “heavy” system or under-estimating the problem involved.

Measuring of safety cultural factors or organizational climate has been seen to be a hot topic in recent research (see Chapter 3, literature review). However, a lot has to be done before such methods become an effective means because there is some doubt of whether "culture can be ‘measured’ at all using quantitative psychometric methodologies such as questionnaires or surveys" (Pidgeon, 1991), or as the only measurement tool (Cooper, 2000). Hale (2000)
questions whether there is such a thing as a ‘safety culture’, or whether it might not be better to talk about ‘cultural influences on safety’.

It is clear from the above discussion and observations, safety management is problematic and its effectiveness is a significant issue. At present, safety suffers from an ad hoc approach that takes too long to generate the necessary capability to deal with the emerging issues, new technologies, new practices; and offers no overarching model through which to map current capabilities against immediate and future demands.

As an "externally-imposed ethical obligation", safety management is presently without a logical mechanism through which to determine priorities and to assess strategic options such as management capabilities. Yet, investigations have not addressed to what extent practitioners contribute to safety management effectiveness and what strategies would promote their management capability in dealing with safety issues in their workplace. I would therefore argue that we should look at “managerial capability” as a strategic issue, and we should question ourselves critically about the relationships between safety goals, capability development as well as how are we going to position ourselves.

1.6 The focus - what is this research about?

The problem I originally planned to address changed considerably after my study had already begun, or maybe it was my view of the problem that changed. The phenomenon I was interested in, i.e. “capability development” in the context of safety management, remained much the same. Initially, I addressed the managerial problem of “How to increase safety management effectiveness and maturity” by means of critical analysis of the key determinants of safety success from an educational and professional development point of view. This included the theory of “novice-expert” transformation, “Expert Theory” as well as education theories. The problem was then reformulated to a more explorative question of “How management effectiveness is affected by capability changes”. It was a lengthy but challenging process involving: searching for a concept, adding concepts, specifying concepts, linking aspects of conceptions; then moving from one category of explanation to another, adding theoretical viewpoints, replacing one theoretical viewpoint with another, and forming an explanatory framework. Finally, the research focus is framed by the questions stated below.

1.7 The research questions

What is the role of capability building in managing safety at work? How does capability building add value to the process of safety management? What are we trying to achieve in the end? To
answer these questions, it is important to start thinking about the underlying concepts, theories, philosophies and their historical roots.

What exactly is the nature of our safety goal? In this study I’m looking for the safety goal that we are trying to address. Presumably, the purpose of externally-imposed safety law and legislative requirement is to get our safety policies and preventive programs to be more effective. Can we work back from our primary safety goal to find out what is most needed to achieve this goal?

In assessing our own weaknesses, strengths and capability against the righteous goal, we will have to have appropriate knowledge and competencies to support them. It entails taking a more evaluative approach to our work, especially in dealing with safety issues in our workplace. For the practitioners and professionals they should be able to reflect critically on their goals, strategic positioning, as well as what capabilities are essential for people to perform their jobs with good safety practices.

In light of the issues arising from the above discussions, the present study attempted to address the follow question central to our understanding of capability building and assessment.

**The key research question:**

How do we shape our safety destiny through capability building, and how can managerial capability be assessed in the context of occupational safety?

In specific terms, the study sought to answer the following questions relating to the main theme in the hope that the answers would be broad enough to permit our understanding of how to build the required capabilities and the way to dealing with the evaluative aspect of the approach:

1. What does safety management means in terms of criticality from a historical perspective? What are the critical issues, and how are they related to a wider notion of capability building and safety functioning?
2. What historical evidence is there for the impact of social, technological and personal factors on workplace safety and managerial practices in recent decades?
3. From an epistemological point of view, how to build capability within the context of safety management? What are the critical capabilities and, in essence, how to assess safety management capability to identify improvement needs?
1.8 Objectives of the research

Capabilities are one of the essential precursors to sustainable performance. They represent the link between strategies and performance. Focus of strategic capability development is to leverage the distinctive capabilities of the organization to achieve the desired state of well-being in alignment with the organization’s strategic goals, for example, in achieving and maintaining the safety well-being of the workplace. The value of capability building can be seen as a management strategy that accelerates and leverage the creation of core capabilities for achieving the desirable state of well-being and human functioning.

The impetus is therefore to consider capability building development as a long term safety solution. The idea of focusing on “capability development” comes from the notion of capability approach advocated by Amartya Sen (1993). But the evaluative aspect is a major concern. The availability of tools for evaluating human accomplishments and functioning is central to introducing the capability approach as an alternative human development paradigm. Thus, a combined measure of capability development is also essential for convincing the policymakers and the public. However, such measures should evaluate development by improvements in capability and functioning instead of simply by advances in fiscal terms. Because of the difficulties of capturing the full complexity of human capabilities in a single index, I ventured to explore alternate means by going through a process of investigation with the following objectives in mind:

(1) to revisit the concepts of risk and safety in order to understand the various risk perceptions and misconceptions, and to redefine ‘safety management’ based on a review of the relevant literature over the past thirty years;

(2) based on the concept of “ways of relating”, to provide arguments that contest the criticality of capability building and evaluative aspect of the ‘capability approach’;

(3) founded on Amartya Sen’s “Capability Approach”, to develop a capability development model and an evaluative framework for enhancing and assessing the capability maturity level of safety practitioners and, at the same time, to determine if there is any hypothetical relationships between the critical capability ingredients; and

(4) to test the hypotheses and understand the maturity level of safety practitioners’ capability by measuring their self-efficacy through empirical surveys.
1.9 Significance of the research

The significance and potential contribution of this study can be discussed from both theoretical and practical standpoints. On one hand the study contributed to a theoretical enhancement of the current level of knowledge in the existing literature concerning the safety management and capability development, and in particular the ways of relating the two. On the other hand, the notion of using Bandura’s self-efficacy theory for the construction of the evaluation tool has proven to be a viable solution to resolve the issues related to the means of capturing the complexity of human capabilities.

In addition, one expected advantage of the proposed model is the framework that will enable any destination to identify critical capabilities in a balanced, coordinated and integrated manner. This is not possible with other existing capability models, in particular the way in which the evaluative aspect of capability maturity is dealt with.

1.10 Structure of the thesis

This thesis describes the challenges and findings of seven years of work that for better or for worse aimed at learning from my strong association with capability development work – training, teaching and developing courses in the field of safety and health. They all contributed in some way to the set-up and realization of the project goals described in the current chapter. The incremental insight into the criticality of capability building and development were gained the hard way.

Up to this point, this chapter has introduced the background of study, the problems to be addressed, the need for a new myth, and what this study is about in terms of its objectives, research questions, emphasis and significance. This introduction provides the rationale of the study as a departing point and highlights the problems that safety practitioners are facing. Safety problems, social expectations, external factors and internal safety problems now impacting on organizations have been explored. To move beyond existing risk conception into new ways of thinking about safety capability, to discover ways of relating risk to safety, to forge new insight and understanding of social responsibility, to stay ahead by building future capabilities, all have relevance in becoming capable of dealing with or preparing for “coincidence” surprises.

Chapter 2: Understanding safety and risk – how risks are coming into being

This chapter represents part of my work on the subject of how risks are coming into being, as a contribution to the understanding of safety and risk. Beyond the formal definitions of risk, I’ve selected some critical factors that can be seen to influence risk perception. I’ve also added some thoughts from philosophy in arguing about risk perceptions, ethical uncertainty, and dynamics of
belief revision. As can be seen in the discussion and arguments, there are uncertainties and changes in themselves, that may or may not exit, and beyond our understanding in ways that we can’t easily conceive – for example, the “butterfly effect” and the “putty problem” that I highlight in two given examples of disaster.

In the final analysis, what is needed is to empower people with knowledge, increasing their ability, expanding the human capability and powers of their individual intelligence, governed by high standard of professional ethics. A viable solution to address the complex, dynamic and uncertain nature of risk and safety is to pay special attention to getting the right capability and right participation.

Chapter 3: How do we shape our safety destiny – a safety management discourse

This chapter assembles and reviews a body of knowledge relating to some critical safety management issues essential for our understanding of how we shape our safety destiny. Building on an understanding of safety and risk, a review is made of the historical grounding of workplace safety issues.

Preventive workplace safety culture, management commitment, staff participation, technological considerations, communication, performance-based and audit strategies, safety culture and organizational safety climate, etc. are what we can find from the research findings in the past two decades. However, in the absence of a generally accepted definition, an attempt was made to define SMS and provide a working definition for this thesis to anchor. In response to the safety challenges and opportunities, this review identified the development of a capability edge as the primary area for future development. This priority of capability development reflects the need for strategic choices that safety leaders and practitioners have to make as required action, development and improvement.

Chapter 4: Building critical capabilities for leveraging human potential

This chapter is a continuation of the discussion on ‘how things are coming into being’ but with special emphasis on the concepts of strategic capability development. In this chapter, I argue that strategic capability development is needed to account for the complexity and dynamic nature of workplace safety. Based on strategic choice, acquired capabilities can inform other learning and capacity building activities.

Using safety management as an example, the capability needs are assessed against its core purpose and strategic development criteria to illustrate how an inventory of critical capabilities can be established. This inventory (and the method of deriving it) can be seen as part of my major research effort that addresses the evaluative aspect of the capability approach. The
work of creating the inventory was an essential part of the modeling process that might be responsible for at least part of it critical functioning.

**Chapter 5: Theoretical foundation and supporting theories**

In this chapter I discuss and present a generic framework for mapping out the context of capability building and development. This chapter provides the theoretical foundation of supporting theories from which a contingency model is articulated. Based on the Chinese philosophy of Yin-Yang, a framework illustrating some dialectic views and theoretical considerations is proposed. The proposed framework is a dialectic view representing the ways of relating ‘capability development’ and ‘human functioning’. Within the framework, an overview of the major theories related to capability development is presented. These include the theory of action, contingency and resource-based perspectives and the conceptual roots of Amartya Sen’s capability approach.

**Chapter 6: Towards a contingency model of “Strategic Capability Development”**

The purpose of this chapter is to present a contingency capability development model – “Strategic Capability Development” (SCD) as an alternate means to provide a long term strategic solution in managing safety at work. It is an integrative paradigm driving a research strategy, in which the phenomenon observed will be based on the action and self-efficacy of practitioners. With a special emphasis on criticality and strategic choices, hypotheses regarding the interactive effects of each of the critical capabilities are derived. These hypotheses predict respectively a positive relationship between goal-setting capability and clusters of critical capability (H1), and a positive relationship between the level of pro-activeness and clusters of critical capability (H2).

**Chapter 7: Assessing safety management efficacy – methodological issues**

This chapter discusses the methodological issues and provides a framework for my empirical study. Based on Social Cognitive Theory of Bandura (1986) and by considering the measuring problems associated with the evaluative aspect the capability approach, this chapter shows how a “Safety Management Efficacy Scale” (SMES) was developed for assessing the safety management efficacy of safety practitioners, as well as the levels of capability maturity and proactiveness.

**Chapter 8: Empirical investigation of safety management efficacy and proactiveness in Hong Kong**

The purpose of this chapter is to report the findings of the empirical study addressing the capability issues that I hypothesized in my propositions. The main part of this chapter describes in detail the testing of the hypotheses using the “Safety Management Efficacy Scale”
questionnaire (SMES), and the analysis of the data collected. This involves formative evaluations, including (a) reliability estimation, (b) correlation analysis, (c) cluster analysis, and (d) collection and presentation of evidence to determine the appropriateness of the hypothesized propositions and their sub-hypotheses. These formative evaluations constitute a major effort that resulted in an excellent opportunity to obtain firsthand knowledge of the capability maturity level of the safety profession as a whole. By examining the empirical data, I was able to describe the profiles of practitioners in terms of proactiveness and capability maturity, and to explain the mutual influences between capability variables as hypothesized earlier.

Chapter 9: Final discussions and conclusions

This chapter looks back at the process of the learning journey about how capability can be built and developed for shaping our safety destiny. The SCD Approach, discussed with respect to what it means to our safety journey, is summarized.

The establishment of measurement tools was central to introducing human development as an alternative paradigm and to gaining the attention of policy-makers. As it worked out, the SMES not only provides a solid tool to scrutinize the concept of complimentarity and mutual dependency between critical capabilities, but can also be used to deal with the evaluative aspect of the capability approach. The evaluative instrument, SMES, can be seen as an effective tool for “taking the pulse”. Based on the same approach and concept of evaluation, the SMES can also be used in other areas to specify new criteria, including development of capability inventories and frequency levels of activities.

Chapter 10: Conclusions, implications and directions for future research: Finally, the last chapter draws conclusions on this capability study, and indicates the areas for further research. On a special note, a “contingency principle of criticality” and a “theory of mutual dependency” have been postulated as part of the outcome, stemming from the theoretical study and empirical observations.
Chapter 2:  How do risks come into being?

2.1 Introduction

Risk is everywhere. In the work environment, it takes many forms: risk of operation failure, risk of injuries, risk of regulatory action, risk of disaster, and so on. The risk to be assessed is always of an event occurring in the future. The assumption is that risk is something virtually intangible at the time when we are doing the assessment. These simple facts, although not always appreciated, may have enormous consequences.

Managing risk is important and the idea of improving safety related skills is inherent in what we do. The capacity and capability to deal with risks are crucial for keeping the “Ship” afloat, although what we are trying to manage may never come into being.

Our perception affects the way we deal with risk but, very often, we are uncertain about what really we have to manage because the percept of risk is unclear. Behind the scene there is a set of principles that affects how an individual or organization perceives and responds to risks.

“Risk management and control”, for many organizations, becomes a kind of capability critical to safety management success and business continuity. Means of measuring and analyzing risk vary considerably. Indeed, means of doing so across different professions may involve different specialists, e.g. an environmentalist deals with environmental risk, a doctor manages medical risk, a mechanical engineer analyzes risk of structural failure, etc. By the term “risk management”, however, I don’t mean managing business risk in fiscal terms. Instead, it is about safety at work – a scope that affects almost everybody.

In this chapter, I’ll try to riff on the wisdom of other people or learn from what happened in the past in order to better understand the nature of risk and its likely consequences. An accident is no coincident. But, where is the source? When does risk become real? Why is ‘managing risk’ necessary if risk is never real? With these questions in mind, the critiques (in this chapter) lie at the heart of disagreements about risk perceptions and management decisions in order to set the context for a capability development discourse. So let’s begin with risk perception – the way we see risk and how we respond to it.
2.2 Risk perception and probabilistic bias

“All cognition is the perception of one thing through another.”

(Valhinger, 1924[1870]: 29)

Most people engage in some kind of dangerous events or work every day. Many of them are seeking to manage risk but not sure when will risk come into being. They are simply guessing because if some of them knew for certain, they would not be dealing with risk (Adams, 1995). In other words, in any definite situation, an adverse outcome may or may not occur and causative factors sometimes distort the probabilities of adverse outcomes (Graham & Rhomberg, 1996).

The word “RISK” means different things to different people. In many ways, however, risk is closely linked with safety – one is negative and undesirable, while the other is positively related to a certain desirable state of well-being.

"The word ‘risk’ derives from the early Italian ‘risicare’, which means ‘to dare’. In this sense, risk is a choice rather than a fate" (Bernstein, 1996). “Taking risks,” says Allan Snyder (5), “that’s one of the main things that drives me.” I wish I could be as open-minded as Allan about taking risks. I mean, I myself don’t see what word better describes the challenges of ‘risk taking’ than what Allan really means. Similarly, Adams (1995:16) claims that “the starting point of any theory of risk must be that everyone willingly takes risk”. This is not in fact the starting point of most of the literature on risk. However, how many people see things his way, at least partially in a visionary way. To a certain extent, Allan and Adams don’t mean the “risks” are really “real”. In fact they are uncertainties.

When risks become real, their consequences could be enormous and sometime tragic. If all risks were real, would Allan, Adam or anyone of us want them to get into the way of our life? If nothing undesirable will happen, why bother?

Towards an understanding of risk

Risk may be considered from a number of perspectives ranging from a narrow view to a broader understanding of its nature. At the narrow end of the scale is the quantitative or probabilistic view held mainly by engineers. This approach takes the stance that risk is represented by the quantitative measure of the probability of an undesirable event. From a technical point of view, a hazard represents a source of energy or physical agent with the potential of causing injury to human being and damage to equipment, environment or structure. As engineers have developed

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responsibility for safety in technology this understanding of risk is often used in the context of safety and is viewed as the probability of failure (Beck, 1992).

Before going deeper into the issue, it’s helpful to see how people define “risk.” Norman Rasmussen (1981) of MIT, in *The Application of Probabilistic Risk Assessment Techniques to Energy Technologies*, defines risk as “the probability that some undesirable event will occur.” Another formal definition of risk is "quantitative measures of hazard consequences expressed as conditional probabilities of experiencing harm," where hazards are threats to humans and things they value (Hohenemser et al., 1985).

“How safe is safe enough?” In an attempt to answer this classical question, Theodore Glickman and Michael Gough (1990) compiled a collection of papers, Readings in Risk, as an introduction to risk. Three papers in the series, related to engineering profession, offer definitions of what they mean by risk by acknowledging that risk perception and behavior associate strongly on a number of critical issues, e.g. characteristics of risks, decision making, content and sources of available risk information.

Risk perceptions, however, may not agree with the general, formal definitions of risk as given by the above authors. For instance, Pidgeon, et al., (1992) defines risk perceptions as "people's beliefs, attitudes, judgments and feelings, as well as the wider social or cultural values and dispositions that people adopt, towards hazards and their benefits." By this definition, risk perceptions are seen to be multidimensional and context sensitive. They are often expressed in terms of two dimensions - the probability and magnitude of harm, and then combined and reduced further to a single dimension, for instance, expected loss. (Pidgeon, et al., 1992).

Things however became more sophisticated and analytical towards the end of the century. In his *Social Benefits Versus Technological Risk*, Chauncey Starr (1996) defines risk in more mathematical terms as “the probability per unit time of the occurrence of a unit cost of burden.” In other words, with this probabilistic approach, risk takes into account both the chance that an event will likely to happen in an estimated period of time, and the magnitude of its possible consequences.

Inevitably, risk is multidimensional in nature. If we look at the keywords highlighted above, we can see risk analysis or assessment is a highly specialized multidisciplinary area involving experts or specialists such as scientists, engineers, chemists, statisticians, systems analysts, psychologists, managers, safety practitioners and policy makers. Therefore we can characterize the differences between formal measures and risk perceptions as a dichotomy between "real" versus "perceived" risk, which implies that risk perceptions and risk analysis are somehow flawed or incomplete (Shrader-Frechette, 1991).
A probabilistic view about risks

Let’s go back to the basic about scientific inquiry and decision theory. It should be acknowledged that the basic task of science theorists or analysts is to obtain agreement on useful conceptions or conclusions of scientific analysis (Hobbes, 1985). In the construction of knowledge and scientific evidence, we need support and agreement on the results of our analysis in order to pursue the use of the findings in a meaningful way.

"Agreement" is a key component of scientific analysis. Agreements on the outcomes of scientific studies (e.g. risk analysis, probability assessment, and frequency rates of accident occurrence), however, suggest unanimity of risk interpretations. The findings cannot be submitted to agreement or acceptance by people who do not grasp the issues so involved. Instead, agreement has to refer to a shared understanding of justifications for supporting the findings. It must be based on a process of rational discourse rather than simply on scientific ground (Zimmer, 1999). In other words, we are in the position, made familiar to us by Habermas (1979), of asserting absolute validity claims which we can only support or adopt contingently. The recursive nature of this process of judging and reasoning reflects only our inability to reach an absolute truth.

From a probabilistic perspective, for example, the suggestion is the application of risk analysis (or assessment) to determine probabilities and set magnitudes on the risks we know exist. If the magnitude is zero, theoretically, the chance of having risk becomes unreal. But, it is simply a guess. Otherwise, the probability is there for us to decide upon. This is a common, simplified approach that involves using probability-based analytical tools such as fault-tree analyses for estimating the likelihood of a perceived fault or its occurrence. Probabilities can be assessed using known relative frequencies which are then extrapolated to the specific context in question. This "frequentist" or “probabilistic” approach incorporates assumptions about the scientific relevance of the available data to the particular context. This kind of approach also incorporates assumptions about completeness and objectivity of the available data.

In the end, the unanimity of interpretation becomes an important part of the probabilistic view. The analytical process, however, would suffer from one basic flaw if the agreement or analysis is incomplete without a broadly based representation of different views.

A positivistic view about risks

Scientific inquiry plays an important role in the analysis of risk. However, as argued in the following sections, such enquiry needs to be carefully distinguished from the probabilistic views that construe "real" risk. It is my primary concern that such views are positivistic but skeptical because they simply affirm that science is the only valid source of knowledge about risk.
assessments and scientific analyses. At most, I would think, in matters of risk and human safety, these positivistic conceptions of risk succeed only in hindering the progress of meaningful dialogue between the scientific community and the lay public on other factors other than scientific understandings.

In classical decision theory, the word "risk" is beyond a positivistic or probabilistic perspective. It describes the situation where both the possible states of nature and the probabilities associated with these states are known (Kläs, 1998). However, many people mistrust available scientific or expert analyses, because they fail to acknowledge the fact that risks are complex and multidimensional – social, technological and/or behavioral (6). In order to minimize possible misinterpretation, it is essential to specify levels of significance as well as the critical parameters. Neglecting this procedure might render scientific analyses or decision-makings susceptible to what I would call “probabilistic bias”.

“Probabilistic bias” assumes those policy decisions affected by risk analysts may have conflicting views or value differences. This assumption is consistent with Dietz and Stern’s (1998) perspective that decisions must not be made until scientific uncertainties are minimized or value differences resolved. Perhaps it would be reasonable to affirm that our risk conception does abut the notion of loss and undesirable outcome with that of ignorance and uncertainty. Beyond our scientific traditions, I think human factors, value differences, ethical concerns and scientific uncertainties are the contingency factors we have to address in order to minimize probabilistic bias. Although this view departs somewhat from the way the word is perceived in most risk analysis contexts, it does convey more accurately the connotation that decision related to risk is dynamic and situational.

One might therefore argue that, in any situation with similar complexity and uncertain characteristics, science alone cannot provide in a timely manner all the needed knowledge. To expand the views of probabilistic and positivistic, knowledge and wisdom from outside science must be incorporated. The process entails some form of broad-based deliberation, participation and shared understanding, recognizing that it will be most useful if there is sufficient interaction between participants and specialists in implementing particular risk related decisions.

The errors of science and the human mind

Science has been a success when applied to the physical realm of matter and energy. But, as things have worked out, human factors and uncertainties make “science” views or the concept of positivism unworkable in risk analysis. The notion of total predictability can only degrade to

6 See Chapter 3 (Literature Review): How do we shape our safety destiny – a safety management discourse.
totalitarianism (Zimmer, 1999). For instance, creativity can’t be objectively measured. An intention can’t be objectively examined from an ethical point of view. Happiness can only be felt but can’t be placed in a test tube. Under table agendas can’t be easily detected. Observations can’t be analytically weighed. It’s also difficult to know whether people will do things according to what they preach to belief. No one can be sure about whether risks are real. Because of these differences and uncertainties, Zimmer (1999) righteously points out that:

‘Any person seriously concerned about Man, his mind, and society needs to be aware of exactly how “science” views and deals with these things. “Science” is fundamentally a method of investigation. The term “science” or “scientific” is erroneously attached to many fields of “study” that have very little to do with an honest application of the “scientific method”.’ -- Zimmer (1999), “The Errors of Modern Science and the Human Mind”.

For a decision-maker the uncertainties are at least as valuable as the specific insights that are gained. It is therefore of vital importance that relevant uncertainties are communicated in a way which reflect their importance in the decision-making process. But, things might turn out otherwise than predicted. In a nutshell, scientists or specialists simply have little training in making visible those things that are not so obvious. Sometimes they fail to communicate relevant uncertainties, and sometimes they fail to provide trustworthy information.

In the end, "science" can and has been applied to the physical environment to improve conditions benefiting the physical survival of human beings, but that is not at all the same as applying "science" to human beings, their mind, and their societies (Zimmer, 1999). But what might that imply?

Two cultures or one?

In many cases, to ignore available figures would be unethical. But to rely too much on them would be far from true. For many people expressing things numerically requires a conscious, and often unpleasant, effort. However, if we go for a solution without any meaningful, reliable data or statistical proof, it is simply not safe or scientific enough from a humanist point of view.

While trying to offer new perspectives, Charles Percy Snow (1993) has drawn our attention to what he describes as the Two Cultures that divide western societies. Snow's basic thesis is that the breakdown of communication between the sciences and the humanities – the "two cultures" – is a major hindrance to solving the world's problems. In the one camp are the self-styled "humanists", and in the other the scientists and engineers, with a vast gap in perceived values and agreement between them (Snow, 1993). Closing the gap is therefore essential. Otherwise "no society is going to be able to think with wisdom," says Snow. Unfortunately, there is no evidence of progress in the past half century, for example, in the cases of the "Space Shuttle Accident" and the “Piper Alpha Disaster (see Section 4 of this chapter).
Should there be two cultures or one? Snow (1993) expresses concerns about what he regards as a widening but worrisome gap of misunderstanding and mistrust between scientists and non-scientists, specialists and non-specialists. One indication of the continuing significant of Snow’s concern is that flare-ups of the two culture controversy persist. Similar to the observation of Theodore, et al. (1990), one of Snow’s idea is that the observed and the observer are interdependent, and the other is the possibility that knowledge, decision, or result of analysis is actually a construction by the observer rather than a discovery of a pre-existing external reality. However, many of us don’t make either claim, and would be more than happy to see participation in the exploration with a wider participation in the various unknown areas that none of us have yet well explored. To do what science is really about, perhaps, we should increase the range and number of observations being made sense of by all of us through broadly-based deliberations, by getting the right participation and by the right people.

A non-conclusion

Primarily, the above argument is that both views of probabilistic and positivistic are inherently characterized by some form of probabilistic bias. Further more, because of probabilistic bias, analyses by risk analysts or specialists tend to mask the understanding of the lay public, and promote unequal development and exchange between the two “cultures”. Thus, probabilistic biases distort the actual relationships between and among specialists and non-specialists, as well as between scientific views and other alternative perspectives.

Perception is emerged from “nothing” to “something” through “a process of acquiring, interpreting, selection, and organizing sensory information” (7). What we perceive and how the objects of perception are related to us are matters of continuing concern. However, perception is nothing if the formation of which is lack of a shared understanding. Perception is also nothing if there is no action to perform any change (for better or worse). In other words, it can be argued that perceptions are formed from “nothing” to “something” based on a process of development involving shared understanding and experience. On this premise, perhaps, we need some fundamental hypotheses about human perception and development, which in turn have grounded in deepest soil of social understanding and self-efficacy.

In the end, people need to be empowered with knowledge, increasing their mental ability, expanding the human capability and powers of their individual intelligence, governed by high standard of professional ethics (Zimmer, 1999). This is indeed the point that the rest of this thesis is trying to endorse.

2.3 Belief and ethical issues

The issue of ethics is closely connected to risk and safety. There are good reasons for asking why risk and ethics have come into such focus. Do we see trends that can explain why these questions appear to be receiving more attention than just a few decades ago? In addition to more traditional teaching of risk perception and risk management through probability calculations and risk analysis, safety management also focus on the individual actions of persons involved in situations where crucial choices need to be made. This leads us to the issue of ethical dilemmas.

Ethical Issues

*Why is the positivistic view of risk often a poor description of social reality?* Firstly, social reality lying behind a phenomenon is often more complex than it appears to be. For example, "the choice of definition can affect the outcome of policy debates, the allocation of resources among safety measures, and the distribution of political power in society." (Fischhoff, 1989: Appendix C at p.258). But, no size fits all. Even with a clear definition of risk, different issues require different treatment – some technical, some social, some ethical, some political and sometimes, knowingly or unknowingly, combinations of these factors. These ingredients have to be considered in order to supplement the inadequacy of available definitions of risk. Risk analysis and assessment, however, ignore the social and ethical aspects of risks. Researchers in the area or risk (Starr, 1969; Rowe, 1977; Fischhoff, 1984) have raised this issue. Unfortunately, so far there is no commercially available model that incorporates social and ethical considerations in risk assessment.

Secondly, risk perception assumes that the perceiver of risk is an institution that selects certain risk for attention or suppresses them from biased perspective (Dougolas, 1985). Very often biases are found in complex situations, for example, the Challenger Space Shuttle accident on 28 January 1986. The complexity, involving a problem of sending people to the space, is beyond our imagination. The various recounting of the disaster vary in length and conclusions. As events unfolded after the accident, the engineers were found to be correct in their technical assessment. Complicated analysis of the so-called, O-rings, and their failure was adopted by many reports to support the engineer's judgment. However, acknowledging such a complexity, Feynman’s observations provide different views and arguments (*see Feynman’s Appendix to the Rogers Commission Report, 1986*). He questions whether the trade-off between listening and following the advice of the engineers and considering other criteria was unethical. The frequency with which this disastrous story is told in relation to ethics certainly implies that someone somewhere must have done something unethical.
Thirdly, some accidents appear to arise from ‘manufactured risk’ imposed by humans rather than by the natural world. This view of risk is in line with Ulrich Beck. He explains this type of risks in his analysis of the “mad cow disease” or BSE crisis, say that “these risks are not fate, but the results of decisions and options that were taken in industry, science and politics … they are the results of efforts to control risk.” (Ulrich Beck, 1997) Beck argues that manufactured risk comes from human intervention through science and technology. Genetically modified foods and the BSE crisis are examples of contemporary discussions of manufactured risks. In these kinds of risk, different mechanisms apply for determining what risk is and how we should respond to it. Some could argue that science and technology was supposed to overcome risk and uncertainty. They do in some respects but in others they have created uncertainties. The advent of manufactured risk comes a range of new situations which need to be analyzed in a different way from different perspectives. The BSE crisis is a perfect example of a new risk environment and the mistakes that people can make. Before the cause of BSE has been finally established, it is ethically and morally not acceptable for a government to declare that these foods are safe. On the up front, in a new risk environment we should take a moral stance that manufactured risks should be avoided at whatever cost if they involve ethical and moral issues that affect the public.

Based on the preceding discussion, what are the ethical questions and issues surrounding safety and risk? Acknowledging the complexity of social reality, biased risk perception and manufactured risk, probably, the ethical dilemma that safety practitioners most commonly confront regarding these issues is a clash regarding safety values and beliefs. Therefore, safety practitioners must be educated about their ethical responsibility and be prepared to discuss and help resolve ethical issues surrounding them.

Dynamics of belief revision

The perception of risk has traditionally given rise to such questions as: Is risk a fundamentally irreducible and unexplainable concept? Do we use a set of beliefs, or a richer structure of language that could be better understood? And if we use a set of beliefs, in what language are these beliefs expressed?

From the onset, when answering these questions it is important to revisit the definitions and given arguments. While the notion of risk has traditionally taken on a number of different interpretations, it has always been some kind of common understandings as well as misconceptions. It is an obvious fact about human epistemology that beliefs are not static. It changes over time. As time goes by, new information is acquired, and beliefs change accordingly. It is a kind of belief revision. As Rowe’s (1977) remarks demonstrate, dynamics of belief
revision is often a source of misconception. When viewed in this way of dynamic change, it can be argued that new understandings are not necessarily better than the old ones or vice versa. Therefore, results of risk assessment over time on the same thing in the same situation with the same objectives by different people may end up with a serious lack of agreement. This dynamics of belief revision, I think, is in similar line with the conclusion of Thompson’s seminal work (1990) about “Risk Objectivism and Risk Subjectivism: When Are Risks Real?”. He states: "the objectivist view makes it too hard for us to be right in making a risk judgment, while the subjectivist view makes it too hard for us to be wrong." (ibid: 105) Thus, according to Fischhoff (1994) experts may disagree because they sometimes:

- rely inappropriately on limited data;
- impose order on random events;
- fit ambiguous evidence into predispositions;
- omit components of risk, such as human errors; and
- are overconfident in the reliability of analyses.

(Fischhoff, 1994: 18)

The conclusion drawn by Thompson (1990) is that neither subjectivity nor objectivity is wholly satisfactory as a basis for risk judgments (Friedman & Halpern, 1999) (8). Drawing from the work of Thompson, there is a need for a new approach that bridges the gap between subjectivity and objectivity in the cloud of uncertainty and differences of belief.

**Risk consequences and responsibility**

The word “responsibility” can be distinguished as either prospective or retrospective (Wit, 1997). It can also be shared or distributed. Given these distinctions, one might ask: “How do these meanings related to the issues of risk and safety?

When accidents occur or when things go wrong, "… there is in each of us a propensity to find someone or something outside ourselves to blame …" (Senge, 1990: 19). It seems that the enemy is always out there!

“Why should I take the blame?” Unconsciously, we often try to excuse ourselves from a problem, by setting up a way of relating "us and them", limits our understanding of how problems can be resolved. This often happens when we unconsciously confuse our jobs with our identities and are totally sunk in the syndrome of “I am my position” (Senge, 1990). Because of this confusion, learning disability creates resistance to change and improvement. In turn,

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8 Some of this work was done while both authors, Nir Friedman and Joseph Y. Halpern, were at the IBM Almaden Research Centre.
learning disability changes our identities. It also limits interaction in response to risk-related decisions because it creates little sense of responsibility in our own position with a learning disability to cope with uncertainties and dynamic changes.

Despite the possible conflicts, and for ethical reasons, why don’t we hold a person responsible with some kind of proactiveness instead of blaming him for various reasons afterwards? Arguably, things may not be so obvious as they seem, for example, one worker comes home safely but another is killed because of an industrial accident. Besides a probabilistic concept of explanation, a proactive approach is therefore much needed to rescue the concept of responsibility in the presence of uncertainties and value differences.

In the public inquiry report on the Piper Alpha accident (9) in which 167 people were killed, a statement implicating the need for shared responsibility was put forward by Lord Cullen, emphasizing the role of prospective responsibility:

“By and large, safety has to be organized by those who are directly affected by the implications of failure. These people are in the best position to determine the detailed measures necessary on their own particularly installation to achieve the safety objective … prescriptive regulation or over detailed guidance may at times result in the overall safety objective actually being compromised. Innovation, on-going improvement and objectivity will be stifled …” (Cullen, 1990:355)

This statement of Cullen’s report makes it clear that safety is the responsibility of those who are directly affected by the consequences. In principle, the responsibility as such is prospective and it entails participation with proactiveness. But, as far as accountability is concerned, the obligation by law makes the responsibility retrospective.

To be retrospectively responsible for something is to be accountable for a certain thing with retrospective effect. But whether the responsibility is prospective or retrospective, the accountability may be in the form of moral condemnation, moral praise, punishment, or reward. It can be argued that, with shared moral understanding, the prospective and the retrospective forms of moral responsibility tend to blend into one another. In both cases, a fulfilled obligation results in praise, whereas a broken duty or obligation entails moral culpability (Wit, 1997).

It is important with respect to the question of holding people responsible for their actions involving moral considerations. But retrospective responsibility may be positive, rather than negative. It is not always necessarily imposed in the form of blame. On the positive side, positive attitude may help create a “non-blame” culture, which is particularly important in dealing with problems and unexpected outcomes related to safety accountability. This kind of non-blame attitude should not only pertain to persons but can also be applied to systems (e.g.

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9 The Piper Alpha was a North Sea oil production platform operated by Occidental Petroleum (Caledonia) Ltd and Texaco. An explosion and resulting fire destroyed it on July 6, 1988, killing 167 men.
organizations) involving human beings. Without a “non-blame” safety culture, the implementation of Lord Cullen’s self-regulatory safety concept would be difficult, if not impossible.

2.4 Butterfly effects – how small things lead to enormous consequences

As argued above, one of the most serious drawbacks to any risk analysis or assessment is perhaps the over-positivistic view and the omission of totally random inputs in dealing with uncertainties. Such random inputs and uncertain factors, (e.g. ignorance, politics, subjectivity, and communication problems) cannot be predicted in any order of accuracy. They are a sort of contingency factors that depend on a particular situation and environment. And yet, when performing the final analysis of a risk catastrophe, they are often the key ingredients in the sequence of events or errors that lead to the disaster (Reason, 1990).

For example, in the “Feynman’s Appendix to the Rogers Commission Report on the Space Shuttle Challenger Accident”, Feynman criticizes that:

“Official management, on the other hand, claims to believe the probability of failure is a thousand times less. One reason for this may be an attempt to assure the government of NASA perfection and success in order to ensure the supply of funds. The other may be that they sincerely believed it to be true, demonstrating an almost incredible lack of communication between themselves and their working engineers.” (Feynman’s Appendix to the Rogers Commission Report, 1986)

Richard Feynman observes that “there are enormous differences of opinion as to the probability of a failure with loss of vehicle and of human life.” Apparently, it is an unacceptable

Fig. 2-1: Space Shuttle Challenger

Photo reproduced from the original Rogers’ Commission Report

About the tragedy: On January 28, 1986 America was shocked by the destruction of the space shuttle Challenger, and the death of its seven crew members. The accident was made especially poignant by the fact that school children all over America watched the tragedy on live television. (Adapted from: University 113 Spring 2005, Rice University, Texas, USA, at URL: http://www.owlnet.rice.edu/~univ113/challengerCont.html)

10 The Rogers’ Commission 256-page report (1986) on the “Challenger” tragedy describes a failure in management, which even today is used as a model in business schools of how not to make a decision.” The BBC.

11 Richard Feynman's opinion of the cause of the accident differed from the official findings, and were considerably more critical of the role of management in sidelining the concerns of engineers. After much petitioning, Feynman's minority report was included as an appendix to the official document (Appendix F).
probabilistic bias. The estimates are so surprisingly diverse, ranging from roughly “1 in 100” to “1 in 100,000”. The findings of Feynman reveal the fact that the higher probability figures come from the working engineers, and, in contrast, the very low ones from management. Within the wide range but unrealistic demarcation, I think, even a layman can tell it is difficult to be more accurate.

“Which one is more realistic? What are the causes and consequences of this serious lack of agreement? Since 1 part in 100,000 would imply that one could put a Shuttle up each day for 300 years expecting to lose only one, we could properly ask: What is the cause of management's fantastic faith in the machinery?”, asks Feynman.

The “Putty Problem” – how one thing leads to another

Joseph Trento (1987) tells us in "Prescription for Disaster" that it won't be pretty for NASA. Many influential authors conducted an in-depth review of the NASA emphasizing the agency's fall from grace after the initial success of the Apollo program. Their studies suggest that there were putative flaws with the organization’s management and R&D system. The loss of the Space Shuttle Challenger is usually ascribed to NASA's decision to accept a safety risk to meet a launch schedule. They contend that the space giants of the 1960s who had successfully pioneered the lunar program were gone. They had been replaced subtly with government bureaucrats who played behind the scene the political game. They “betrayed” the Space Shuttle as an inexpensive program in an unconscious process sowing the seeds of disaster. Trento (1987) contends that:

“[The astronauts] would have no way of knowing that a 1977 Consumer Product Safety Commission ruling banning asbestos in certain paint products would have a tragic effect on the flight. NASA had used an “off the shelf” putty manufactured by the Fuller O'Brien Paint Company in San Francisco to help seal the field joints of the SRBs [solid rocket boosters] through the first ten missions. Fuller O'Brien, fearful of legal action because of the ban, stopped manufacturing the asbestos-based putty.” – Joseph Trento (1987: 281)

How small things may lead to enormous consequences? Here is a typical example but a very tragic one that many still vividly remember. According to the Presidential Commission’s report, a flawed decision-making process at the space agency is claimed to be the main reason of the tragedy. A history of problems is well-documented, citing that the O-ring and a dramatic last-minute protest by engineers over the Solid Rocket Boosters as evidence of managerial neglect. However, Vaughan (1997) makes the case that “the Challenger disaster was a product of an organizational culture that normalized deviance”. Central to her argument is the notion that “people assess risk based on their own past experiences and worldview”. (see also Baker, 2004) Besides Roger’s Commission Report and Vaughan’s sociological narrative of the disastrous
event, journalists and investigators have different views. They argue and cite managerial wrongdoing and production problems as the reasons behind the scene.

Furthermore, there are untold stories that the public does not realize. For example, in retelling the story, Rowe, et al. (2004) suggest that it is probably the asbestos that caused the disaster. It was not simply the O-rings that failed. But, probably, it was the putty that held the O-rings in place. Although there is no hard-fact evidence, “data from previous flight suggest that both the primary and secondary seals failed to seal properly at low temperatures,” Rowe, et al., (2004) explain. Up until that time, asbestos, as an essential ingredient, had been used to strengthen the putty and made it temperature retardant. “Because of an EPA (Environmental Protection Agency) ban on the use of asbestos, a non-asbestos containing putty was substituted which didn’t have the insulating fire-retardant powers of asbestos.” (Ray & Guzzo, 1993: 178) Thus, it is believed that when the asbestos was removed, it was the putty that gave way.

In the final analysis, no one seems to know whether what has been learned is complete with all these archival evidence. However, I would say the “putty problem” is a kind of “Butterfly Effect” that clearly shows how small things may have enormous consequences.

The “Butterfly Effect”

“How, in human affairs, does one thing lead to another?” asks Philip Ball (2004) in his recent book, Critical Mass. Why is society the way it is? How does it emerge from a morass of individual interactions? Is anything inevitable about the ways humans behave and organize themselves? These probing questions, I think, move us further along in exploring the nature of human affairs about the underlying cause-effect relationships, for example, “How do we shape our safety destiny?”

Do accidents occur by accident? Clearly the answer is ‘no’. Not a chance: no accident can have been caused by accident. That’s my answer.

Chaos theory (12) teaches us that small events can have enormous, but sometime disastrous, consequences. There is a bizarre movie called "The Butterfly Effect" (2004) (13) telling us that a butterfly's flapping wings in Asia can create a hurricane in North America.

We all have moments when we wish we could change something, for example, to correct a mistake, gain love and power. What if we really could? To find out, we could ask some

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12 Chaos theory, in mathematics and physics, deals with the behavior of certain nonlinear dynamical systems that (under certain conditions) exhibit the phenomenon known as chaos, most famously characterized by sensitivity to initial conditions.

13 “The Butterfly Effect” Directed by Eric Bress and J. Mackye Gruber, 2004
provocative thinkers to riff on Chaos Theory (Edward Lorenz (14), 1960) or Heinrich Domino Theory (Heinrich, 1931), and explore the interplay of cause effect in our lives. Surprisingly, the kind of “Butterfly Effect” could probably be found in the classical cases of tragedies: “The Piper Alpha” and the “Space Shuttle Challenger Accident.” We learn from the tragedies that small things such as the “condensate pump”, “safety valve”, rubber “O-Ring” or the “putty problem” can lead to disasters (see the Rogers Commission Report, 1986; Lord Cullen’s Report, and the many other published commentaries and scientific observations).

What do tragedies have in common?

Similar to the case of the Space Shuttle Challenger that I discussed earlier, the Piper Alpha tragedy (that I’ll be talking about) teaches us almost the same lesson – the “Butterfly Effect” or the “Putty Problem”. Although in no way we can generalize what we might learn from the incidents, what is in common to the Piper Alpha and the Space Shuttle is something conceptual, not something simply scientific.

In the late 1980s in the United Kingdom, there was a series of disasters, each of which shocked the world. “Even today the roll-call is painful to recite”, said Frank Doran at the Hansard (House of Commons Daily Debates (15)), 30 March 2004. He also summarized the facts that: “In March 1987, the Herald of Free Enterprise ran aground off Zeebrugge, with 192 dead; in 1987, the King’s Cross underground fire left 31 dead; in July 1988, the Piper Alpha oil platform disaster left 167 dead; in 1988, the Clapham rail crash left 37 dead; in 1989 the Kegworth airline crash left 47 dead; in 1989; the Hillsborough football stadium disaster left 97 dead; and in 1989, the Marchioness river boat sinking left 51 dead.” It is a kind of “Corporate Killing” as the caption of the report suggests.

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14 The first experimenter in chaos was a meteorologist, named Edward Lorenz. In 1960, he was working on the problem of weather prediction.

The disaster with which I’m most familiar is Piper Alpha (see Figure 2-1). As a case study that I often use it for the teaching of my safety students, I always quote what Lord Cullen (1990) stressed in his public inquiry report on the Piper Alpha tragedy. He says there were:

“significant flaws in the quality of [the oil company’s] management of safety which affected the circumstances of the events of the disaster … Occidental management should have been more aware of the need for a high standard in incident provision and firefighting.”

Lord Cullen’s report (1990) concludes that “the initial condensate leak was the result of maintenance work being carried out simultaneously on a pump and related safety valve. Piper Alpha’s operator, Occidental, was found guilty of having inadequate maintenance procedures.” Similar to the “Putty Problem” in the case of the Space Shuttle, Cullen’s report points to the “condensate leak”, rightly or wrongly, as the result of maintenance malpractice. But, “practically, all offshore workers in the North Sea would dispute the sincerity of the industry in some of their responses to the Cullen Report. Certainly the oil companies' response to Cullen's recommendation for full, organized worker representation has been less than full-hearted.”

In the final analysis, Lord Cullen concludes in his report that “Occidental management should have been more aware of the need for a high standard in incident provision and firefighting.” But, based on the above arguments, seemingly, no one is absolutely sure about where is the “butterfly”? Obviously, the accident was not by accident. The “butterfly” must be somewhere in the jungle. Unfortunately, people are often forgetful. Something disastrous happened again 17 years after. The space shuttle Columbia\(^{16}\) broke apart on Saturday, killing all seven astronauts and plunging the nation into a sense of grief not felt since the last tragedy seventeen years ago.

### 2.5 The “ways of relating” risk and safety

Given the above examples, what then have we learned from these tragic lessons? What are the critical issues? How do these issues relate to safety? How to get away from the pitfalls or at least narrow the gap between true probability and probabilistic bias? Let’s see how things relate to one another.

In the following sections, I’ll give a brief account of the ways of relating some critical issues with ‘risk and safety’. These issues illuminate the underlying assumptions which strongly influence our understanding about how we can shape our safety destiny in the long run. They can be quite useful both to specialists wishing to clarify subtle distinctions between perceptions and

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\(^{16}\) “Space Shuttle Columbia Disaster” February 2003, at URL: http://www.havenworks.com/space/shuttle/columbia/
to non-specialists by providing some insight to the problems. In some cases these ways are meant as mutually exclusive, such as “risk consequences” versus “safety responsibilities”; in other cases, one way might lead to and become incorporated within another, such as “anticipation” and “proactiveness.” In some cases, each way is meant as a characterization of the relation distinguishing between risk and safety per se; in other cases, they only apply to specific understandings about accidents.

**Understanding safety and risk uncertainty**

To understand ‘safety and risk’ it would be useful to think about: “How are risks coming into being?” It seems that very often risk will become real when we don’t believe it will. Accidents, however, don’t occur by accident.

Risk is something odd, pertaining to the nature of a coincidence, but that is not equivalent with being unlikely (Wit, 1997). Even with all the innovations and improvements in the last thirty years, on fundamental question remains unanswered: “Why do train or aircraft crash?” It is probably the unexpected combination of multiple events and errors that yields an unpleasant surprise. That surprise makes us exclaim: ”What a coincidence!” Similarly, it is the kind of coincidence implicated by Reason’s “Swiss Cheese Model” (Reason, 1990). After all, it is typically the actions or inactions of people that are directly linked to the accident.

Reason proposes what is referred to as the “Swiss Cheese Model” of system failure (Reason, 1990). He considers that, to varying degrees, every step in a process may have the potential for failure. As a metaphor, Reason regards a stack of slices of Swiss cheese as a system. He considers each of the slices as a “defensive layer” in the process and the “holes” to be opportunities for a process to fail. An error, be it human or physical, may allow a problem to pass through a hole in one layer but the problem should be upheld in the next layer because the holes are not always in good alignment with each other. Each layer is therefore considered as a defense against potential error affecting the outcome.

In a non-technical sense, risk is a notion closely related to uncertainty and probabilistic bias. In performing risk studies (e.g. risk assessment) one has to make methodological choices, sometimes related to alternative conceptions of the very notion of risk. It does, for example, make a difference if we treat industrial risks in the framework of the technical system itself (e.g. by conducting "fault-tree analysis" or “job hazard analysis"), or if we include human agency and perhaps the cultural background or safety climate as well \(^{17}\).

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\(^{17}\) Related literature includes: Cox & Cheyne, 2000; Flin Mearns, O’Connor & Bryden, 2000; Glendon & Stanton, 2000; Glendon & Litherland, 2001; Guldenmund, 2000; O’Toole, 2002; Mearns, Sean, Whitaker & Flin, 2003.
Despite popular safety belief, we can see that risk management is seldom linked with business strategies. The orthodox view is that this “island of uncertainty” is often beyond the comprehension of business owners and workers even though the whole thing can be seen as a social responsibility. People think ‘safety first’, but it is concealed within their subconscious instead of an explicit requirement identified with consciousness. Their general awareness is low even though there are rules and regulations imposed-externally by the government or regulating bodies.

**Anticipation as a priori mental process**

Proper inference of probability can only result from an intentional and a priori mental process (Peirce, 1993). In risk assessment and analysis, statistical inference is made and conclusions are drawn on the basis of data that are available. The data allow us to identify patterns and find probabilities. With these data we can check whether the indications of probability are valid and significant. In Peirce's terms, it is important for us to understand that the predicate of the major premise must be clearly defined and determined before information is gathered. The outcomes are often affected and determined by our intention and capability. We can usually find what we are looking for. Therefore, the ability of ascribing probability of a certain effect to a certain class of risk depends on the presence of knowledge and capability with such risk characteristics, from which we can infer.

**Anticipation and proactiveness**

Given above an account of perceptions and probabilistic bias, risk analysis needs to go far beyond the mere statistical probability calculations. While the operational risk control approach involves evaluation of existing operations to identify, prioritize and control potential risks, it should also aim at encouraging appropriate risk responsiveness and safety proactiveness, as well as getting the right participation by those people who are directly affected by safety failure.

Proactiveness about safety is a concept that refers to the ability to adapt and respond to perceived risks. Proactiveness does not simply act in response to its environment, but exhibits opportunistic and goal-directed behaviour. In general terms, it is concerned with implementation, which is necessary to bring a safety and risk management concept to fruition (Covin & Slevin, 1989). It usually involves considerable perseverance, adaptability and a willingness to assume full responsibility for failure. To the extent that an undertaking demonstrates some amount of awareness, knowledge, capability, preparedness and proactiveness, it can be considered as ‘proactive activity’ or *proactivity*. 

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As envisaged by Lord Cullen (1990) in his public inquiry report on the Piper Alpha disaster, goal-setting and self-regulation in managing safety at work is unequivocal:

“Not only must the objectives be set, but specific, albeit minimum, standards must be imposed by legislation, so there is no doubt as to the minimum standard for compliance.” (Submission to the Piper Alpha Inquiry, Day 177, 47c, quoted from Foster & Woolfson 1992:17).

Given this paradigm of proactiveness, each risk analysis, interpretation or assessment technique can be considered as an autonomous agent that co-operate and communicate with other agents. Co-operation and broad participation can be viewed as providing the opportunity for the agents to converge. The co-operating agents or broadly-based participative approach offers a number of advantages over the single solution technique. Firstly, results of analysis and interpretations can be made more reliable through the cross-checking of results. Secondly, early solutions can be derived with broad participation and these can then be incrementally refined for as long as is deemed necessary. This means the overall approach has a capability supported by broadly based participation rather than relying heavily on a few specialists.

**Biases in risk and safety information**

Implementing any safety strategy requires not only accurate treatment of definitions (e.g. risk attributes and levels of probability) it also entails understanding the role of safety information, attention to format selection (e.g. ratings, rankings, or choice), and careful statistical analysis. However, the typical complexity of risk phenomena necessitates simplifications (ISCSU’s Standing Committee on Responsibility and Ethics in Science, 1999). This requirement for simplicity provides for new challenges related to the methodological choices even though some professional codes of practice are there to guide us in case we are in need of advice.

While risk and safety related information is available from sources as diverse as national standard authorities, government authorities or agencies, professional bodies, equipment manufacturers, and even this thesis, they all have some biases in what is reported and analyzed. For example, the aviation risk and safety information presented by any source is created in response to a need or to answer a question. Most of the information is created to identify the risk of fatality in a particular context such as by industrial accidents. Any information provided by a government or other safety agencies also has a purpose. The key question for anyone seeing that information is whether that information coincides with one’s information needs. If it does coincide, the need will likely be satisfied. If it does not, then one must take the next step.

A true safety question deals with subjective questions and judgments that can’t be objectively measured. The responses are different for each person. In that light, safety is very much like an art. The aesthetic judgment of which is difficult to make. There is no clear division
between whether it is beautiful or lack of beauty. Two people can have entirely different standards for beauty and yet the standards would both be legitimate.

At organizational level, current legislation or safety standards do not describe how to create an effective risk management system. Most of them can seem to be overly bureaucratic, promoting process over substance. For example, for emphasizing performance over what makes the system sustainable, and for putting too much attention to operational programs over the capability development requirements. Very little concerns have been given to issues of participation or communication. These readily available standards and codes of practice have equipped us with a systematic, operational framework for the development and implementation, but they have not been prepared to specify a list of functionings that can be used for capability development. Hence, the main challenges facing anyone working within the current risk assessment of management framework are how to identify and prioritize among valuable functionings and the critical capability required for achieving these functionings for the human well-being. Moving down the road, there is a need to survey with clarity the most prominent contributions in the literature, in particular to develop an account of the central human capabilities necessary for managing safety and risk.

**Social implications**

In a wider social context, crises such as the implications illuminated by the tragedies in the above discussion have prompted us to question the traditional probabilistic approaches to risk. In justifying validity claims, the traditional method of risk analysis has been characterized by the finding of facts, asserting statistical reliability and seeking scientific evidence. This no longer works in complex situation, or with complex working environments. Therefore, new models of public engagement are most needed, shifting the emphasis away from authority to individual involvement, from passive reaction to proactiveness, and from knowing to doing. As Robin Grove-White writes,

> "Industrial innovation plunges ahead in areas of relative scientific ignorance. Regulators and ministerial advisory committees stumble along behind, discovering by trial and error the implicit pitfalls, seeking to contain and mitigate them. Meanwhile, Ministers lean on the absence of conclusive proof or evidence of harm, and the inherited (but increasingly brittle) social authority of a particular positivistic view of science, to keep the show on the road." -- Grove-White (1998)

The suggestion represents a fundamental shift away from the traditional model. We need to move toward openness, public deliberation and broadly-based participation. In the past, risk was seen as a technocratic issue exclusively for specialists to manage. A typical approach according to Grove-White (1988) could be as follows: identify and define the potential risk, using scientific analysis; define the scope and level of that risk, using assessment methodologies; decide how to
proceed, using cost-benefit analysis; and finally, defend the decision and, in particular, those individuals who will be affected. Increasingly, this common practice has been found to be inadequate. It fails to address some important issues of implementation, e.g. risk communication capability development and participation.

In a wider social context, risk communication has a collective meaning. Theories on communicative discourse are rooted in the argument that all communication consists of complex messages that allow people to communicate risk with one another (Littlejohn, 2002). Complex messages are those whose messages that are clear and coherent. Shimanoff’s (1980) rule theory states simply that when people communicate with one another, they are following a set of rules that govern the process of their message sending and receiving. Apparently, this is something missing in Grove-White’s approach.

The process should be driven by the need to make a decision and by the concerns of policy-makers and those who are affected by the decision. As far as capability development is concerned, success in managing risks depends on attaining four key objectives (National Research Council, 1996):

- Getting the capability right,
- Getting the right capability,
- Getting the right participation, and
- Getting the participation right

In light of the inherent complexity of risks and decisions, organizations will have to develop new capabilities and revise existing practices to implement the approach. Organizations may require increased flexibility in procedures so these new perspectives can be incorporated in risk management. Most important, organizations should develop mechanisms that provide feedback on their procedures so they can be improved over time.

Putting it all together, the National Research Council (1996) report makes a series of strong epistemic arguments that broadly based deliberation makes for better-informed decision. Three salient points, pertaining to ‘understanding risk’ (ibid, 1996:79-81), are adapted as follows:

- broad participation ensures that all the outcomes of concern receive consideration and not just those are readily quantifiable, thus providing a more complete picture of the choices available and their implications;
- broadly-based deliberation can help determine the appropriate uses for potentially controversial analytical techniques and the appropriate interpretations to put on their results; and
- broadly-based deliberation can help identify which disagreements among the parties interested in a decision might be resolved by gathering further information.

**Opportunity and Participation**

Capability development in many countries (e.g. Japan, Korea and Taiwan) has earned a remarkable reputation for its contribution to strong economic success. Access to opportunities and freedom of participation are the major factors in capability development. In this context, Amartya Sen attributes the recent success of the Chinese and India economy to their social commitment to universal access to basic education provisions (Sen, 2001).

Sen’s approach can be defined as “freedom of development”, which is, in essence, the removal of various types of “unfreedom” blocking people’s access to development opportunities. Thus, the approach cannot be dissociated from participation. It is something basic to human development that the outcome of which is something that people has reason to value (Sen, 2001). This perspective, I would think, has practical consequences in that it suggests that if people have reasons to value their personal safety and health, they should be provided with access to participation rather than unexpected encounters by chance. Their states of safety well-being are typically non-transferable and of fundamental importance to a person unless he or she chooses to ignore his or her own safety. Therefore, any direct provision of safety protection measures for individuals would have some face value but at the expenses of reducing the level of individual safety awareness.

In his capability approach, Sen’s view consists of three distinct aspects: the process aspect, the growth aspect and the opportunity aspect. They are important for sustainability of improvements. In the process aspect, Sen argues strongly that participative forms of decision making should be valued in their own right by policy makers as an ultimate goal of development. Whereas, in the growth aspect, participation is valuable only in so far as it contributes positively to the attainment of specific goals. With regard to the opportunity aspect, Sen argues that in pursuing the view of development as freedom, “we have to examine – in addition to the freedoms involved in political, social and economic process, the extent to which people have the opportunity to achieve outcomes that they value and have reason to value” (Sen, 1999a: 291).

**Outcomes expectancy in matters of safety**

In order to better understand Sen’s meaning of ‘outcomes that they have reason to value’, it is necessary to distinguish between ‘outcomes of self-expectancy’ and ‘outcomes of external expectancy’.
According to Julian Rotter’s (1954, 1960, 1966) expectancy theory, expectancies are mental representations based on past outcomes and the situation people now confront. Rotter (1954) believes that people’s behaviour is closely linked with and affected by a certain set of reinforcers. A reinforcer could be as simple as a “thank you”, a token of appreciation, or tangible outcomes. It is something that people value (e.g. monetary rewards or some kind of incentives). If people don’t see the link, then they react less predictably to reinforcers. From this viewpoint, expectancies have a causal influence on our behavioural choices (Rotter, 1954). Moreover, Rotter sees outcome expectancy, or “locus of control”, as a general phenomenon whereas subsequent research suggests that it may be specific to certain circumstances. "Internal" locus of control is regarded as “high general expectancy”. It is because of this kind of internal expectancy (e.g. job satisfaction), people are self-motivated, and their behaviour reacts more predictably to reinforcers and learning is more likely to occur. In contrast, "External" locus of control is concerned with “low general expectancy” that people don’t see as much link between their behavior and the likelihood of being rewarded.

The concept outcome expectancy applies to safety as well. The implication of this ‘expectancy theory’ is that people’s expectancy judgments, in matters of safety for example, have a causal influence on their behavioural choices. Reinforcers are not clearly linked with people’s behavior, especially when risks are not obvious and the state of safety well-being is often taken for granted. Although safety is a desirable feature of well-being, its outcome is not immediately visible and becomes a kind of low general expectancy until something goes wrong. These negative consequences (e.g. accidents) stemming from safety ignorance are the ‘outcomes that they have reason to value’. But Sen doesn’t put it quite like that. However, in a positive way, if he takes safety as an ingredient that affect human’s well-being, his argument still stands.

2.6 What is the chance?

Where observation is concerned, chance favours only the prepared mind.

-- Louis Pasteur (1822-1895)

Where ‘accidents’ are concerned, they often happen when we are not prepared. Like SARS (18), we never know until it happened. Is it by chance? Or, is it predictable?

As pointed out in the previous discussion, safety is closely linked with risk, and risk is a combination of a specific consequence and a probability. Based on this common understanding, one might ask a question of the form “What is the chance of its happening? This question is the

18 SARS: Severe Acute Respiratory Syndrome. The etiologic agent of SARS is a coronavirus which was identified in March 2003. The initial clusters of cases in hotel and apartment buildings in Hong Kong have shown that transmission of the SARS virus can be extremely efficient. Attack rates in excess of 50% have been reported.
most difficult to answer because safety is not a concept that lends itself to a simple definition because of uncertainty, belief and ethical issues, and the many other factors just described (see also Chapter 3). Some safety questions are actually risk questions in disguise.

**When are risks coming into being?**

If anything can go wrong, it will.
If anything simply cannot go wrong, it will anyway.”
-- Murphy's Law

When is risk becoming into being? Is the safety target of “Zero-Risk” possible? To a certain extent, these questions are about probability, inferring that probabilistic approach is a viable methodological choice. Considerations about these questions suggest that the notion of ‘real risk’ is challenged by a number of conceptual difficulties as discussed in the previous sections. By positing risk with a hypothetical question of “Zero-Risk”, in effect, we are assuming the possibility of certain reliable knowledge, analysis and mitigation. In particular, we are promulgating the view that there exist certain levels of confidence of risk analysis, or certain values to which we should strive for in our risk evaluation. This position is fundamentally misguided, and our capability of doing that is largely over-estimated. This position has been seriously challenged by risk philosophers and theorists on a number of fronts (Zimmer, 1999).

Accordingly, the risk realism paradigm provoked by the question, “Are risks real?” can have a potentially positive influence on our efforts to achieve the cognitive objectives of risk analysis. Implicitly, by asking such a question about risk realism (20), we are trying to force ourselves to position that the merits of adopting a strict sense of the notion of ‘real risk’ must be judged in terms of the cognitive objectives of risk analysis (Wit, 1997). By adopting such a position, risk could be generally construed as an ideal to which we should strive for in our analyses although in the end its objectives can never be met.

**Do accidents occur by chance?**

We live in a world filled with uncertainties, chance and luck. But safety is not a game of chance. These less explored factors of chance and uncertainty complicate the risk issues and dilute the control efforts that people have made over their life and their work (Wit, 1997). Although, in the prediction and control of risks, “the scientific community has come a long way in predicting and

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19 **Murphy’s Law** (“If anything can go wrong, it will”) was born at Edwards Air Force Base in 1949 at North Base. It was named after Capt. Edward A. Murphy, an engineer working on Air Force Project MX981, designed to see how much sudden deceleration a person can stand in a crash.

20 Definition according to Webster’s 1913 Dictionary: (Philos.) As opposed to nominalism, the doctrine that genera and species are real things or entities, existing independently of our conceptions. According to realism the Universal exists ante rem (Plato), or in re (Aristotle).
taming probabilities, coincidences such as accidents will always remain unavoidable although not at all irreducible” (ibid). Where opportunity is concerned, chance favours only the prepared mind. But, where ‘accident’ is concerned, it happens when we are not prepared.

Chance is often closely linked to awareness and anticipation. Sometimes, it is close to our mind – because mindfulness in its totality has to do with the quality of our awareness. In a positive way, Louis Pasteur (1822-1895) rightly points out that “where observation is concerned, chance favours only the prepared mind.” The chance is that it only exists by virtue of anticipation (Wit, 1997). However, accidents are often regarded as unexpected and undesirable events. They are negative outcomes or consequences that people do not usually expect. In cases of tragic events, things to which final cause belongs may be done by nature (e.g. natural disasters), by thought (e.g. ignorance), or very often by our behavior (e.g. unsafe acts). Some involves politics, beliefs, value judgments, ethical issues or other social factors. And some simply ascribed the causes of accidents to unsafe conditions or unsafe acts. In my view, as discussed in Chapter 1 – the ‘boiled frog syndrome’, people at work are far too complacent about their state of well-being and they tend to ignore the risks surrounding them if nothing disastrous has happened on the spot.

We have long argued that an accident is not an unexpected surprise but, to a large extent, a result of human errors – ignorance, being unprepared, lack of awareness or not well-informed. Shelton (1999) argues that human error is the largest source of system failures and that human error is a major factor that makes systems safety critical. But if we ask ourselves, as a safety practitioner, about how much do we know about human factors and their implications. I’m afraid the answer would be: “Well, not quite!”

**Dichotomization of risk – “nothing” or “something”**

‘Safety’ is not a subjective equivalent of ‘risk-free’. The idea of *risk-free* is sometimes misleading. For people to feel safe they are not necessary to be convinced that a particular risk is at zero or negligible level. Instead of relating safety to the pragmatic, social and ethical context of a hazard situation, after all it is about trust in those charged with protecting oneself. It is simply a matter of self-regulation.

When authorities dichotomize safety measures into the ones that are required and the ones that are not mandatory, in effect they also dichotomize risk itself. A risky situation is *something* that calls for mandatory precautions regardless whether it is mandated by law. Situations that are *nothing* risky call for no precautions. The case for voluntary precautions and prevention is also the case for acknowledging that risk is not a dichotomy.
Dichotomizing risk might work out all right if the dividing line of the dichotomy were someplace reasonable, for example, a level “As Low As Reasonably Practicable (ALARP)”.

However ALARP does not actually constitute a clear boundary between a risky situation and risk-free condition. "The dichotomization of risk," say Segal and Sandman (1990), "distorts the reality that nothing is absolutely safe or absolutely dangerous, and polarizes 'more-or-less' disagreements into 'yes-or-no' conflicts." If people are going to see risk as a dichotomy, they are far likely to dichotomize the situation that either the risk is zero or the risk is serious. Since zero risk is usually unattainable, dichotomizing at zero therefore leads to risk management standards that are also unattainable.

When people argue that we can’t be sure the enemy is out there and we must therefore take additional precautions. It is because if something really turns out to be an “unwanted surprise”, we have no one to blame but ourselves. In short, we should not be surprised when organizations want an expert to certify the status their safety management system rather than involving staff to commit themselves to voluntary precautions for their own good. The question is: “We got nothing here to deal with risks! Shall we resolve to develop our own capability instead of seeking external “expert advice”?

The solution to all this is to point out that risk is not a dichotomy, and neither is paperwork or a compliance audit according to what is required by law. It is always possible to do more (or less) about a risk. We are taking the precautions we think best but we are open to argument about whether we drew the line too far to one side or the other without understanding the reality. The underlying issue is whether we have the capability to deal with these safety or risk issues.

2.7 Building capability: some basic justifications

Why does the need for capability building change over time? Every organization should ask itself where the opportunities are to broaden the deployment of existing capabilities to strengthen its position. Management can sustain safety at work only if the key players and stakeholders are able to develop the required capabilities and put them into effective use. Building capabilities required conscious effort. This effort is not very different whether an organization is creating new business, new processes or new technologies. Whether such effort is undertaken, and how well it is managed, varies from organization to organization, according to the nature of its business, management, strategy and resources. In matters of safety, it also depends on the working environment in which the organization functions.

The success of organizations in upgrading their capabilities depends on many factors. The interactions inherent in capability building and development constitute a coherent system of
incentives and strategies to which people respond in their learning effort. Capability building is, however, an empirical property of a learning process, it is therefore subject to empirical investigation, e.g. it can be evaluated by dealing with the evaluative aspect of the method, or by assessing the outcomes of a process in relation to goals and objectives to be achieved.

Building capability and matching process with decisions

The Committee report, "Understanding risk: Informing decisions in a democratic society" (National Research Council, 1996) suggests that failing to involve stakeholders in risk (or safety) management decisions can lead to the inability to effectively implement those decisions. According to the report, this limited approach, with limited participation, is “seriously deficient”. The report therefore redefines risk with the ultimate goal of increasing stakeholders’ acceptance of risk assessments and their safety responsibility. However, it also argues that making risks understandable to the public involves much more than translating scientific knowledge (e.g. the results of risk analysis) into non-technical terms. The diagnosis suggested by the report is to build organizational capability that matches the process to the decision.

The report emphasizes the need to involve interested and affected parties early in the process for coping with complex risk situations. This involvement should carefully integrate scientific and technical analysis with a deliberative, information-gathering process. The aim is to produce a more useful risk characterization, which the Report defines as “a synthesis and summary of information about a hazard that addresses the concerns of both decision-makers and of interested and affected parties”. In many recent controversial risk decisions, issues and questions raised by public officials and concerned citizens had not been included in the initial formulation of the decision or in the analysis and characterization designed to inform it. Hence, the Report emphasizes the need to involve interested and affected parties early in the process for coping with complex risk situations. This involvement should carefully integrate scientific and technical analysis with a deliberative, information-gathering process. The aim, in the end, is to enable a more useful understanding of risk. It is about risk characterization as well as risk communication.

Capability and self-efficacy

What then shall we expect? With a question like this, it is important to understand that hazard responsiveness and preparedness is people's perceptions in terms of their 'outcome expectancy' and 'self-efficacy'. Outcome expectancy describes the level to which people believe that their personal actions will be capable of mitigating risk, and self-efficacy about whether they believe that they are competent to carry out risk reduction measures and to act effectively deal with the consequences of hazardous events. As suggested by Albert Bandura (1997), self-efficacy
particularly seems to affect the diversity of action plans that people will develop, as well as their
effort and perseverance in carrying out risk reduction activities. Even in dealing with risks of
very rare nature (such as volcanic hazards of a very remote nature), capability and plan
development are important factors, as hazards occur only rarely and risk reduction and readiness
activities need to be sustained over prolonged periods of time (Paton 2003).

Self-efficacy, in safety context, covers the belief of the individual towards his own
capability to make decisions and take control actions regarding a risk issue, and the input he/she
can have towards management of the risk issue. There are reasons to believe that personalized
risk information will be more likely to influence people to change their self-belief and behavior
than more general information about risk. For example, with limited knowledge about a
particular risk, an individual may feel that he/she can do nothing about exposure to the risk,
whilst a well-informed individual with a more internalized locus of control may perceive that
something should and must be done on a personal level about a particular risk issue. For some
proactive individual, with a good understanding of risk and safety (e.g. the possible
consequences), may develop the required capability to adapt to adverse demands using his/her
own resources.

2.8 Discussion

This chapter defines some common language for discussing risk and safety and sets out some key
aspects of the complexity and uncertainty of risk that challenge the traditional way of thinking in
scientific analysis. As just discussed, risk perceptions are socially constructed. The construction
of these perceptions is affected by some traditional thinking. For example, some are probabilistic
and some are positivistic, but unavoidably with some kind of probabilistic bias. In examining
these views, objectivity and subjectivity were also discussed. Together these critical issues have
forced a reappraisal of how we should link our risk perception with safety proactiveness,
participation and capability development. All these will have long term impacts and implications
on how we deal with uncertainty and probabilistic bias, and the way that we shape our safety
destiny in a dynamic, complex working environment.

What does an inability to deal with risks show us about relations to other perceptual,
cognitive and social ‘faculties’? We have seen that some researchers attribute the safety problem
experienced by people with fragmented views leading to a breakdown in social understanding
and in making connections between risk and safety. One could say that, according to Vaihinger
(1924), all cognition is the perception of one thing through another. It seems that when we
perceive risk as something undesirable but likely to happen we extend our understanding of risk
and create consciousness and awareness. However, signs of risk emerge, after all, only in the
process of interaction between individual consciousness and understanding of the consequences of undesirable happenings. Such understanding and connections (e.g. between causes and effects) are crucial for anticipating, evaluating or imaging the consequences of one’s own and other’s risk perception and behavior. In this regard, a breakdown in making connections not only the effect that people find it difficult to understand risks, it also means that many people have not real sense of danger. So, ‘connection’ and ‘risk perception’ are intimately linked. They are linked, as Damasio (1999) puts it in a way that risk perception and our well-being are created “from the beginning of the evolution of consciousness.” He points out that our well-being comes from our consciousness. “It is not just the price of risk and danger and pain. It is the price of knowing risk, danger and pain.” (Damasio, 1999: 316)

So, in partial agreement with Damasio’s thinking, my postulation is that our ways of making connections or ways of relating things are important in the perception of risk and danger, but making connections can also exaggerate or distort the perception of risk on the individual and social level. To me, imagined or deluded dangers without rational groundings are often much more dangerous than real ones.

The price that we pay would be unpredictable when risk is coming into being. However, in the face of ‘risk dichotomization’ (see Section 6), there is a need to strive for a balance and cross-matching between fact and fiction. In fact, risky situations call for mandatory precautions regardless whether they are mandated by law. When authorities dichotomize safety measures into the ones that are required and the ones that are not mandatory, in effect they are dichotomizing risk itself. When we argue that we can’t be sure the risk is there we are denying the probability of its existence. But, when things turn out to be an undesirable surprise, we have no one to blame but ourselves. However, don’t be surprised, because of the law, people want experts to certify the status their safety management system rather than involving staff to commit themselves to voluntary precautions for their own good.

Shall we resolve to develop our own capability instead of seeking external “expert advice” or relying on others to protect our well-being? This thesis certainly attempts to make the argument.

2.9 Chapter summary and discussion

Understanding probabilistic bias and the natural evolution of risk from “nothing obvious” to “something unexpected” are some of the important concepts addressed in this chapter. Understanding the butterfly effect, uncertainty, probability and probabilistic bias in a positive way helps reshape our risk perception. Because of these complex contingency factors and probabilities, we need something simple to deal with the issues. The idea of “nothing leads to
something” is one of the alternatives to provide a simplistic answer. Philosophically, it is something to do with simplicity. In fact one of the puzzlements in the philosophy of science concerns simplicity. Some philosophers have approached the issue of rationalizing or justifying simplicity principles by arguing that *simplicity has intrinsic value as a theoretical goal* (21). Sober, for example, writes:

Just as the question ‘why be rational?’ may have no non-circular answer, the same may be true of the question ‘why should simplicity be considered in evaluating the plausibility of hypotheses?’ (Sober, 2001:19).

When several observable facts or possible theories are compatible with experience, some theorists and philosophers incline to choose the simple one, where simple theories are somehow more uniform or consistent than complex ones. Because of this line of thinking, further down the road, there is a need to survey with clarity and simplicity the most prominent contributions in the literature, in particular to develop a simplified approach that could help us achieve the desirable future functionings for our well-being.

My critiques about risk and safety were intrigued by the questions: *Are risks real? How are risks coming into being? And, do accidents occur by accident?* Using the examples of the *Space Shuttle accident* and the *Piper Alpha disaster*, I’ve explained how small things might lead to enormous consequences. The “butterfly effect” is further exemplified by the “putty problem” highlighted in my discussion about the Space Shuttle incident. The implication is that we should challenge our traditional thinking and reliability of scientific methods by bringing in and linking risk with other non-scientific issues – value differences, dynamics of belief revision, ethical uncertainties, information biases, communication, decision making, outcome expectancy and development opportunities.

Risks will become real even if we don’t believe they will. Understanding risks involves seeing “ways of relating” facts and anticipation, ethical values and social implications, scientific and biased information, consequences and responsibilities. The undesirable consequences and unfortunate happenings also connect our experiences of the past, the present and the future, and most importantly, they connect what we do and think now with what we do (or don’t do) next, depending on how we want the future to be.

Risk perception is dynamic and situational. In light of the inherent complexity of risks and decisions about them, organizations will have to develop new capabilities and revise existing risk management strategies to suit their particular situation. By building and developing the

21 Simplicity: Most philosophers believe that, other things being equal, simpler theories are better (Stanford Encyclopedia of Philosophy). URL: http://plato.stanford.edu/entries/simplicity/
required capabilities, I advocate a simplistic view with a strong belief that a capability approach can help narrow the gaps between differences of value, judgment, perception, probabilistic bias, and resolve some of the human factors. Through capability building, all the expertise that will be needed will be found and developed within the organization, meaning that extensive use of costly 'experts' could be avoidable.

All in all, to keep the ‘ship’ afloat, what is needed with people is empowering them with knowledge, increasing mental ability, expanding the human capability and powers of their individual intelligence, governed by high standard of professional ethics. Thus, a viable solution to address the complex, dynamic and uncertain nature of risk and safety is to pay special attention to involving participation of the right people and equipping them with the right capability.
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Chapter 3: How do we shape our safety destiny – a safety management discourse

3.1 Introduction

Building on an understanding of safety and risk (Chapter 2), this chapter assembles and reviews a body of knowledge relating to some critical safety management issues essential for our understanding of how we shape our safety destiny. In conducting this review, differing meanings in definitions and a variation of terms have been observed. In the absence of a generally accepted definition, attempt was made to define SMS and provide a working definition as an anchor point for this thesis.

A brief review of safety research in the past twenty years suggests that the subjects, locus of study and safety perspectives vary from time to time. Categorically, these perspectives can be generally classified into five distinct areas: social, technological, organizational, cultural and performance based. It is also acknowledged that preventive workplace safety culture, organization climate, management commitment, staff participation, technological considerations, communication, performance-based and audit strategies, all have an important role to play. However, not much attention has been given to the role of capability development, in particular what ‘capability edge’ needs to be developed and maintained in managing safety at work.

An introduction to safety management discourse and past research leads to an appreciation of the need for a sustainable approach. This priority of capability development reflects the need for strategic choices that safety leaders and practitioners have to make in our journey that shapes our safety destination.

“Destiny is not a matter of chance, it is a matter of choice. It is not a thing to be waited for; it is a thing to be achieved.”
-- W.J. Bryant (22)

3.2 Role of safety management - a catalytic role

According to ILO’s statistics, fatality rates in parts of the Middle East and Asia soar to four-fold those in the industrialized countries with the best records. Certain hazardous jobs can be from 10 to 100 times riskier. Given this situation of international concerns, Cabrera Juan Somavia, Director-General of the International Labour Organization (ILO), called upon international attentions by stating that:

“The success of our effects [to promote the goal of basic protection for all workers] depends on mobilizing our constituency in the world at large including the many committed professionals in the occupational safety and health community. I would, therefore, like to call on governments, employers’ and workers’ organizations of our member States and the international community to put the elimination of workplace hazards at the top of the public agenda.” (Somavia, 2000)

It is clear from the above ILO statements that health and safety at work is a world-wide issue and social obligation, and there is no doubt that safety management plays a catalytic role in insuring both workplace well-being and effectiveness of business [Clutterbuck & Baranski (WHO) 2002]. It is evident that there is a need to develop the necessary knowledge and confidence in managers and safety practitioners to develop and maintain the system for managing safety at work (Walker & Tait 2004), for example, “skills to write a policy statement and carry out a risk assessment”. This is especially the case in performing a risk assessment, in deciding which hazards are to be included and what control measures are appropriate in each case (Health & Safety Laboratory, 2001). There is also a need to develop the necessary knowledge and confidence in managers and safety practitioners to maintain and develop the system for managing safety at work (Walker & Tait 2004).

The need is quite obvious. However, safety management in Hong Kong for example is problematic and its effectiveness is a significant issue because of its relatively short history since its introduction by law in 2002. Safety practitioners are perplexed, for example, what kind of safety and prevention activities is essential and what sort of strategies can be adopted to provide an appropriate response to the dynamic, changing safety needs.

3.3 Safety management as an externally imposed obligations

Safety issues have been raised in importance by the public attention that has been paid to them in recent years. Through public pressure and continual government interventions, safety management has become obligatory although the intention is to make safety management self-regulatory in a positive, proactive way. However, for many organizations, these issues are regarded as externally imposed by expectations of society and the government.
Externally imposed obligations (EIO)

Every choice bears a consequence. There are no exceptions. Yet we often rely on other people to tell us what to do? What are our rights and obligations in matters of workplace safety? The capability approach of Amartya Sen (1999a) on freedom has been used in management studies to analyze the ethical aspects of participative governance (Collier & Esteban, 1999). However, in matters of safety, freedom sometimes means escape from EIOs and commitments because of value differences. From this perspective, leaving things to chance appear to be a common cause of human suffering from accidents and injuries.

These EIO issues to a certain extent involve the concept of solidarity (Durkheim, 1893) and the ethical aspects of participative governance. It is, however, not my intention here to explore the historical evolution of these concepts, but it is important to highlight some of its meanings in order to understand what is meant by EIOs. The idea of labeling safety issues as EIOs was originated in the question of the relation of the individual to social solidarity. The common social and ethical obligations constitute what Durkheim called ‘mechanical solidarity’. Durkheim considers the beliefs, practices, and consciousness of a group, community or society to be coerced on individuals as actors. Durkheim argues that it is individuals who act, but they do not act purely on an individual basis. Rather, they have obligations and duties. They generally act in ways that are strongly influenced by the social structures (e.g. religion, legal systems, and moral values) of which they are part (Hadden, 1997). In his theoretical model, Durkheim (1984) advocated the development of “occupational groups” as the means by which the interests of special groups could be promoted. For Durkheim, these would promote the general interests of the society as a whole more than just their own interests. In advocating this, he comes close to some versions of pluralism. For example, in acting and reinforcing under the law, the concept of solidarity can be reduced to a co-determining role – one is regulating and the other is complying.

In response to the laws and regulations, Tolbert and Zucker (1996) makes a more or less disguised reference to situations where organizations comply with external forces in order to survive. While laws and regulations can avoid in general the worst abuses of ethical and social principles, they cannot produce positively ethical and anticipated outcome without the support of organizations and stakeholders concerned. Nevertheless, by law, EIOs must be dealt with if the

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23 Emile Durkheim (1858-1917): French social scientist and a founder of sociology who is known for his study of social values and alienation. His important works include The Rules of Sociological Method (1895). [See also the biography of Emile Durkheim at URL: www.relst.uiuc.edu/durkheim/Biography.html]
organization is to continue; that is, be ‘licensed’ or ‘authorized’ to operate, and be free to carry on business without interference (e.g. airdrome licence for airports). In other words, an EIO issue is defined by a parameter that might cause the business to be shut down. In making this definition, absolute compliance is not a central issue. Rather, it is the resolve to treat the issue as being obligatory and to respect the external, social imposition. Therefore, responsibility for the discharge of these EIOs lies not only with the organizations but also the individual members as well.

**Barriers to dealing with EIO Issues**

To deal with EIO issues, it entails a new kind of management strategy and capability edge. There is a need for more attention to internal factors like the configuration of the organization’s resource base and capabilities, and the long-term objectives within the control of management, while acknowledging the impact of external factors, such as legal duties and legislative requirements. Responsibilities for the discharge of safety duties represent a kind of social obligation although, for many small indigenous organizations in Hong Kong, the main challenge is concerned with basic survival while some large companies and organizations may afford the use of “modern” management methods to deal with this kind of safety issues. When organizations are inevitably constrained in how they can react to the legal requirements that they are powerless to change unless they have the capability to cope with the situation and the changing requirements.

### 3.4 Defining the safety management concepts

If we look into the development in the last two decades, a great deal of effort has been made by researchers, academia and regulators to investigate and develop system approaches to address safety and the working environment. There is a mutual understanding about the key dimensions of safety. However, the shared understanding about the concept of safety has not led to similar developments in the definition of "safety management system" (SMS).

A survey of literature reveals that no formal definition for SMS or “safety management” seems to exist. Some may feel that lack of agreement on the meaning of these safety concepts is rather esoteric. However the argument put forward in this chapter is that, until a clearer perception of the concepts of safety is perceived, the profession will be limited in its ability to develop its expertise or capability to meet with growing challenges ahead. The following review outlines the extent to which these concepts have been explored (or defined) and details the development and some of the limitations of present modes of thought. An alternative perspective is then offered as a working definition for this research.
Definitions of SMS

The concept of safety management has evolved from a long tradition across many countries. The European Council Directive 96/82/EC defines a Safety Management System (SMS) as the organizational structure, responsibilities, practices, procedures, processes and resources for planning and implementing accident prevention policies (Mitchison & Porter, 1988). For the Health and Safety Executive, main functions of safety management include policy, organizing, planning and implementing, measuring and reviewing safety performance, and auditing for continual improvement (HSE, 1997). The British Standard Institute (BSI) defines a SMS as "a composite, at any level of complexity, of personnel, resources, policies and procedures, the components of which interact in an organized way to ensure a given task is performed, or to achieve or maintain a specified outcome" (BS 8800, 1996). Authors such as Travers (1997) contend that the successful health and safety management [HS(G)65], developed by the Health and Safety Executive (HSE), provides the basic criteria for an effective management system.

These definitions boil down to the fact that both HSE and BSI recommend a similar set of elements of occupational safety and health, based on the BS EN ISO 14001 management system. The basic concept is illustrated in Fig. 3-1.

![Fig. 3-1: The safety management system (BS 8800, 1996)](image_url)

Other definitions or system descriptions can also be found in research publications, for example, Bentley & Sockley (1992) describe a SMS, which consists of an understanding of the hazards of ‘safety-critical’ operations through hazard management analysis. Based on similar concepts, informal definitions are developed by other researchers. For example, Ming (1994) defines SMS as the policies, objectives, organization, management controls and resources which are in place to manage safety, health and environment in all parts of the business. More specifically, in the field of process engineering, Burkhardt (1994) defines process safety management as "the application of management systems to the identification, understanding, and control of process hazards to prevent process-related injuries and incidents"; while Whittingham and Holloywell
(1994) contend that an effective SMS needs to be a more formalized version of existing management systems for the control of both safety and production. They also suggest that effective safety management results from the combination of a SMS structure and the organization's safety culture.

**Defining SMS in terms of framework, principles and guidelines**

Besides definitions, SMS is often described in terms of framework, guiding principles or guidelines. In a study using an audit approach, Schweigert, House, & Holness (1999) discuss the eight *guiding principles* for SMS developed by the Canadian Pulp and Paper Association for its member companies. These guidelines suggest that system ownership, goals and procedures, measures of performance, review of measures, and corrective action are the key components of a SMS that must be in place. The selected elements of the management system are chosen on the basis of a generic model of management systems that are similar to closed-loop processes in other disciplines.

In defining SMS, some organizations derive their systems from environmental standards such as ISO 14001 Environmental Management System (EMS), consisting of policy, planning, implementation and operation, measurement and evaluation, and review and improvement. Ming (1994) and Bentley, Mundhennk, Jones, Geert de Jong, and Visser (1995), for example, describe a SMS, which consists of establishing goals, organizing and allocating resources, establishing the performance standards, planning, implementation, auditing and reviewing the system for compliance and improvement.

Other organizations, such as the European Process Safety Centre (EPSC), develop SMS *guidelines* for their members, which also consist of similar features, such as policy, organization, management practices and procedures, monitoring and auditing, and management review (EPSC, 1994). Similarly, the SMS guidelines developed by the Exploration and Production (E&P) Forum are in general agreement with those adopted by EPSC. These guidelines provide a useful reference frame based upon a common set of critical SMS components - leadership and commitment, policy and strategic objectives, organization, resources and documentation, evaluation and risk management, planning, implementation and monitoring, and auditing and reviewing (E&P Forum, 1994).

**Defining SMS with emphasis on risk management**

More recently, focused attention has been given to the management of risks and criteria of system success. A study conducted by Kandola (1997) suggest that "a management system must enable the assessment of risks to be carried out and as a result devise and implement adequate
risk reduction measures and provide appropriate feedback mechanisms for further improvement". Other researchers, such as Reason (1997), contend that "an effective safety management means actively navigating the safety space in order to reach and then remain within the zone of maximum resistance". Also from a risk perspective, Tinmannsvik (2003) defines the term ‘safety’ as: "to what extent the occupational accident risks from an activity are acceptable and ‘as low as reasonable practicable’, i.e. the ALARP principle (Reason, 1997). This definition makes the safety concept dynamic and a relative term, and implies systematic efforts in order to monitor and minimize risks.

**Defining SMS as an aspect of overall management function**

As an aspect of overall management function, Mitchison and Papadakis (1999) argue that safety management serves to determine and implement the organization’s safety policy. This involves a series of activities, initiatives, and programs, which focus on technical, human and organizational aspects and refers to all the individual activities within the organization. From a system point of view, these activities are associated with the concept of continuous improvement through ‘control loops’, which involves planning, organizing, implementing, evaluating, checking the outcome against the plan and objectives, and taking corrective action.

Current safety management practices are still following a prescribed list of safety rules and regulations, forming safety committees, displaying safety posters and banners, and conducting accident investigations in accordance with statutory requirements. As in the old days, none of which correlate safety with business performance (Hammer, 1989), and the approach has been primarily reactive.

To improve the unsatisfactory situation, Rahimi (1995) suggests to merge strategic safety, health and environment into total quality management (TQM) based on the premises that the concepts of TQM and Strategic Safety Management are complimentary in nature. However, like TQM, the philosophy and concepts of strategic safety management require firm and unconditional commitment and dedication from everyone at all levels of an organization. The major problem in implementing the proposed integrated approach, according to Rahimi, is:

"the difficulty by which personal goals can be aligned with the organizational strategic objectives".

**Summary of definitions**

In sum, no formal definition for "safety management system (SMS)" seems to exist. Very often the term is described as a kind of management system consisting of a set of interacting elements or in form of guidelines for managing safety at work in an organized way. To summarize:
(1) SMS, according to The European Council Directive 96/82/EC, is defined as the organizational structure, responsibilities, practices, procedures, processes and resources for planning and implementing major-accident prevention policies. (Mitchison & Porter, 1988)

(2) SMS, according to BS 8800, is a composite, at any level of complexity, of personnel, resources, policies and procedures, the components of which interact in an organized way to ensure a given task is performed, or to achieve or maintain a specified outcome. (BS 8800, 1996)

(3) Safety management as the application of management systems to the identification, understanding, and control of process hazards to prevent process-related injuries and incidents (Burkhardt, 1994).

(4) An effective SMS needs to be a more formalized version of existing management systems for the control of both safety and production, which consist of a combination of a SMS structure and the organization's safety culture (Whittingham & Holloywell, 1994).

(5) SMS, in form of guidelines, consists of policy, organization, management practices and procedures, monitoring and auditing, and management review. (EPSC, 1994; E&P Forum, 1994).

(6) From a risk perspective, the term ‘safety’ is partly defined as: the extent the occupational accident risks from an activity are acceptable and as low as reasonable practicable, i.e. the ALARP principle (Reason 1997).

(7) SMS must enable the assessment of risks to be carried out and as a result devise and implement adequate risk reduction measures and provide appropriate feedback mechanisms for further improvement (Travers, 1997).

(8) As an aspect of overall management function, safety management serves to determine and implement the organization's safety policy. This involves a series of activities, initiatives, and programs, which focus on technical, human and organizational aspects and refers to all the individual activities within the organization (Mitchison & Papadakis, 1999)

**Characterization of SMS**

As can be seen from the above review, while not very exhaustive, the findings do suggest that no formal definition for 'safety management system' seems to exist. However, based on the above summary, the informal definitions can be further generalized as follows to become a more formal definition:

(1) the *purpose* of SMS is to reduce the probability and/or consequences of potential hazards
(2) safety management is an integral part of overall management (Rahimi 1995);

(3) SMS is a combination of technical, organizational, or combined management functions;

(4) work environments are undergoing constant organizational, technological, economic, legislative, social, ethical and cultural changes. (HSC, 1999:6);

(5) safety functions appear to be quite similar in different industries and sizes of operation (see also, Dejoy, 1991, 1993)

Furthermore, categorically, all the safety functions can be further characterized as "strategic" activities and "operational" activities (Brun & Loiselle, 2002). Some of which can be regarded as "proactive" measures while the other are taken as "reactive" by nature of the activities involved.

**Proposed definition of SMS**

It is difficult to apply a simple classification system on all types of safety functions and activities (Harms-Ringdahl, 2000). The complication is concerned with "PURPOSE" or "INTENTION". It seems that the concept of intention is a bit more complicated than its literal meaning. Thus, the definitions need to be further clarified if the word purpose or intention is used as a symbolic meaning in classification. As far as the definition or terminology is concerned, this difficulty with "purpose" or "intention" also affects the general definition and representation of the key safety management functions. Therefore, these two words are considered not suitable because of the difficulty in assigning safety management a definite purpose in view of its multidimensional and situational nature. However, what is possible to define is that there could be a combination of different technical, social, managerial and organizational functions involved in a safety management system.

Based on above review, observations and deliberations, a *working definition of SMS* for this research is therefore proposed:

A safety management system: The systematic development and application of a combined set of technical, social, managerial functions and organizational capabilities, which can reduce the probability and/or consequences of potential hazards in a specific working environment.
3.5 Is there an identifiable safety management movement?

Safety management is an emerging process. Throughout the history of the development of safety management, the adoption of broader management concepts and safety practices is evident. As can be seen from the above review, the evolution in defining SMS over the past two decades suggests that safety management is a key accident prevention strategy. Key milestones included: (1) the influence of scientific management on safety management (see Heinrich, 1931, 1959), (2) associated safety practices and behavioural considerations arising from industrial psychology and social research (see Section 3.6 of this chapter), and (3) the introduction of business and quality management strategies in the 1960s.

In the mid-1980s saw a resurgence of interest in a systematic approach to safety management, catalyzed by three factors:

1. a tremendous impact on the high-risk industries (given rise by the Bhopal disaster) to ensure the operation of effective safety management systems;
2. a renewed focus on innovative management practices aimed at integrating safety with business performance; and
3. a new style of legislation stemming from the Robens Report (1972) in Britain, which has now been progressively adopted and enacted in many countries.

In most of the western countries, at the end of the 60s, accidents rates were rising, and this was occurring in spite of increased investments in safety and related education. Later, particularly in the 1970s and 80s, a third factor came into play. This factor was concerned with the risks of accidents associated with the surging growth in the development of technologies, which has come to be widely accepted of as catastrophic (Dwyer, 1992). The increased visibility of industrial accidents has become a growing social concern. On the one hand, a range of social movements began to focus on the issue of increasing accident rates in industry. On the other hand, governments took initiatives to renew their legislation related to the social and ethical needs.

Despite all these changes, however, the major research literature review of the period, carried out by Hale and Hale (1972) in Britain, concluded that "In no area has enough work been done ... and radically new theories are needed ...
" (Hale & Hale, 1972: 80-81). In 1982, Singleton, subsequent to a detailed comparative analysis of Switzerland, Britain, and the United States, concluded "There is no indication as yet of the value of all the vast investment in safety research and legislation over the past decade" (Singleton, 1982: 98). He remarked that "It is not going to be easy for the system to evolve the radical new thinking which now needed" (Singleton, 1982: 168).
Since then, three separate phenomena have combined in the last two decades to influence the development of safety management in theory and practice as well as people's assumptions of its basic value in organizational context. The impact and turbulence has been widespread, starting from the Western world and extending to most industrial countries, as accidents have become one of the major public concerns.

What has been done after Hale and Hale (1972) and Singleton (1982) about the general inadequacy? Is there an identifiable safety management movement? The next section of the review will look at this issue from a historical perspective, in particular the research that has explored the concept of safety over the past two decades.

### 3.6 Safety Research in the past two decades

During the past 20 years, as reported in literature, two basic approaches have been used to examine the safety scope and functions: (1) the conduct of broad-based surveys of working safety practitioners or industrial organizations, and (2) the development of theories and conceptual models that attempt to represent the major roles of risk and the safety functions. The studies by Minter (1988), and Kohn, Timmons & Bisesi (1991) are representative of the first approach. And there have been several attempts to develop models of industrial safety functions and risk/accident models using the second approach (e.g. the Heinrich’s Domino Theory, 1931; Bird’s Model, 1976; and Reason’s Cheese Model of Human Error, 1990).

On conceptual models, for example, many researchers have taken a systems approach, focusing on barriers and control. The barrier or control concept, based primarily on Eliyahu M. Goldratt’s *Theory of Constraints* (TOC), is common in nuclear safety, but also in other areas (Goldratt, 1984). The identification of a safety barrier can be of technical nature, or involves administrative control measures, for example, safety inspections. From a system point of view, the barriers can be on different levels in the system hierarchy. The barrier concept has been applied in several accident and safety analysis models (e.g. Svenson, 1991) or James Reason’s Human Error Model (which also known as “Swiss Cheese Model”, Reason, 1990).

Research into the topic of occupational safety has grown exponentially over the years. A wide range of occupational safety issues have been examined in research studies grounded on different perspectives. Changes came primarily in the form of legislation due to increasing social pressures and disastrous events. Review of the SMS approaches suggests that the subjects, focus of study and research perspectives varies from time to time. These perspectives can be generally classified into FIVE distinct areas - social, technological, organizational, cultural, and performance-based.
(1) Social perspective

Workers' view of their jobs, the motivations behind their risk taking and risk perceptions are being increasingly referred to in safety research. Over two decades ago, there was a tendency for researchers to examine the problems from a sociological perspective. In sociological analysis, action is interpreted as being produced by social relations, in which people's relationship to their tasks is managed. Gradually, the limitations of traditional approaches to prevention are forcing safety researchers, administrators and regulators to refer to what sociology might call the significations that workers attribute to their own actions. (see, for example, ReVelle & Boulton, 1981, 1982).

Ethnographic studies of workplace safety suggest that some workers are risking themselves in return for higher wages or for reasons of productivity enhancement (Riemer, 1979; Fitzpatrick, 1980; Carson, 1982; Dwyer, 1983). Research has also shown that organizations characterized by bureaucratic, centralized and rigid management have more difficulty adapting to change than do organizations whose management is decentralized and flexible (Lawrence & Lorsch, 1967).

New theoretical insights on social process and of their relationship to accidents have been built. Mechanical failures or individual fault are no longer seen as the crucial variables that explain how accidents occur. Nevertheless, I would think the focus is too narrow to just examine the internal human factors and, to a large extent, ignore the external influences on the workers and employers as a whole. Rather, explanation should be based on far more interactive approaches that integrate the diverse disciplines into a wider perspective as discussed below.

(2) Technological perspectives

Advances in technology and the fast-paced development of new products can give rise to substantial improvement in productivity and provide opportunities to eliminate old hazards, but they may also create new or unrecognized risks to workers. For example, the new industry of recycling small household batteries is exposing workers to hazardous levels of mercury, a neurological poison (NIOSH, 2005). The cleaner-burning, reformulated fuels now required by the U.S. Environmental Protection Agency in the United States are resulting in reports of respiratory irritation by service station attendants. Another example is computer CRT displays on visual fatigue. The increased use of computers in the workplace has brought about a number of health concerns. Many people who work at a computer report a high level of job-related complaints and symptoms, including ocular discomfort, muscular strain and stress (Collins, et al., 1990).
In industrial context, the evidence accumulated so far suggests that technological changes have not always had a proven universal accident preventive effect (Blank, Laflamme & Andersson, 1997). New statistical models and methods are therefore needed to predict hazards associated with new products, materials, tools, or processes. Also needed are new mechanisms to anticipate and evaluate the potential adverse safety consequences of these emerging technologies in order that effective control measures can be developed and applied.

Indeed, we seem to have evolved into having a rather blind faith in technologies that often are misunderstood or misapplied, and into placing trust in system and people involved with them, even though they have not proven entirely trustworthy (Neumann, 2003). Technological and organizational changes engender new managerial practices that, depending on how change is managed, can bring about a reasonably long-lasting transformation in managerial policies and work practices. For example, in the early years most technical change came to radiology as incremental improvements to existing techniques, but a stream of new computerized imaging equipment began to infiltrate radiological work, e.g. computed tomography (CT) and magnetic resonance imaging (MRI). These new medical imaging devices, as the results of technological changes, challenge traditional role among radiologists and practitioners concerned (Barley, 1986). These technologies may sometimes alter the organizational and occupational structure of radiological work. However, current theories of technology and organizational form are insensitive to such kind of implicit change of role. Bailey argues that "In so doing, technology is treated as a social rather than a physical object, and structure is conceptualized as a process rather than an entity ..." (Barley, 1986: 78)

While the social construction of technology research approach adds some further insight to the understanding of technological change that affects safety in our workplace, I would therefore argue that technological development is not a linear process of change with only one possible outcome. During the processes of technological change, situations appear to be 'malleable'. It can take different forms, and as a result, the work environment can be affected in different ways. However, different actors or stakeholders articulate different definitions and understanding of the priorities, issues and problems to be solved. The different goals, values and assumptions are derived from their 'technological' and 'organizational' frames. These include goals, key issues, problem-solving strategies, capability of staff, design methods and criteria, and safety practices.

(3) Organizational perspective

When the concept of SMS was introduced in the early years, safety management often excluded workers or staff participation in decisions that affect themselves. The Rogers Commission (1986),
for example, in its report on the 'Challenger' accident, made numerous recommendations, some of which reflect on the problems of staff (or operative) participation. It suggested that operatives be included in decision-making processes and their basic assumptions and safety values be taken into account by management. "NASA should encourage the transition of qualified astronauts into agency management positions ... into their position flight experience and a keen appreciation of operations and fight safety" (Rogers 1986: 199).

The improvement of working conditions and workplace safety are also part of a wider set of innovations in the management of an organization, in the same way as new technologies (Conrad et al., 1992; Witte, 1993). Cohen and Cleveland’s study (1983) shows that the effectiveness of workplace accident prevention depended on, among other factors, strong senior management support. The study also suggests that effective safety management accords real priority to safety in policy and action, and includes safety as an integral part of the organizational decision making process. To share general characteristics of successful safety program, organizations have to set safety goals, assign responsibilities, provide adequate resources, identify and deal with potential hazards, motivate and involve employees, and evaluate safety performance (Cohen & Cleveland, 1983). However, for some managers, particularly in small and medium-sized organizations, workplace health and safety is not an organizational responsibility, but is instead a moral issue for the individual worker, an issue in relation to which the employers have no legitimacy. In these cases, workplace health and safety is left in the hands of the employees (Eakin, 1992).

The dominant theories in behavior research are borrowed from social psychology, and tend to emphasize cognitive processes as well as immediate social influences on the individual. One of the most obvious shortcomings of such theories and models is their neglect of other factors beyond this domain or some latent factors that can’t be easily seen. Although economic factors, legislation, enforcement of legislation, and aspects of our cultural, organizational, and physical surroundings are widely accepted as crucial in safety promotion and safety behavior change, only a few effective models however have incorporated these factors in a holistic way.

(4) Cultural and behavioural perspectives

The concept of ‘safety culture’ has received considerable attention and represents an important development of theoretical perspectives in research on injury prevention in the last decade. Moghadam (1998: 18) links culture to social norms, defining culture as "a normative system that prescribes how one should behave in given contexts". According to Reason (2000: 11), "culture transcends the psychology of any single person". Safety behavior is claimed to depend on cultural factors, and to vary systematically across cultures.
The concept of safety culture is an outgrowth of ‘safety climate’. It was introduced by Zohar (1980) as part of the broader climate concept. It consists of a combination of safety hazards, aspects of management control, and employees’ perceptions of its effectiveness (Williamson et al., 1997 and Flin et al., 2000). Although organizational climate and safety culture are important, it was not systematically studied until recently (24).

The beginning of organizational culture period of safety research, accident investigation and analysis can be traced back to the nuclear accident at Chernobyl in 1986. After the disaster, increased attention was paid to safety climate or safety culture in workplaces with advanced technology, complex systems, and potential for catastrophes in order to understand the influence of cultural factors on safety behavior (Pidgeon, 1991; Reason, 1997) – for example, in the offshore (May, 1998), nuclear (Rosen, 1997) and shipping (Payer, 1998) industries. Gaining international currency over the last decade, safety culture is nevertheless loosely used to describe the corporate atmosphere in which safety is understood to be the number one priority (Cullen, 1990).

The concept of ‘safety culture’ has largely developed by the OECD Nuclear Agency (1987). It was observed that the errors and violations of operating procedures occurring prior to the Chernobyl disaster were evidence of a poor safety culture at the plant and within the former Soviet nuclear industry (Pidgeon & O’Leary, 2000). Although well intentioned, such aims illustrate the confusion that surrounds the safety concepts and methods of implementation. This confusion appears to “emanate from fragmented and unsystematic empirical efforts using underspecified theoretical concepts” (Kennedy & Kirwan, 1995). Maybe it is due to a lack of an underlying integrative framework (Flin, 1998) which can be used to guide the safety culture construct in a wide range of industrial and organizational contexts.

Various factors and sub-components have been proposed for identifying and measuring safety culture (Reason, 1997 and Lee, 1998). But the criticism has been made that safety culture is reduced to simply a combination of administrative procedures and individual attitudes to safety (Pidgeon, 1998), and that considerations of politics and power are absent. Also, there is some doubt of whether "culture can be ‘measured’ at all using quantitative psychometric methodologies such as questionnaires or surveys” (Pidgeon, 1998: 204), or as the only measurement tool (Cooper, 2000). Hale (2000) questions whether there is such a thing as a ‘safety culture’, or whether it might not be better to talk about ‘cultural influences on safety’.

The various cultural studies suggest that management has a key role to play in influencing an organization's safety culture. The study of Thompson, et al. (1998) indicates that different levels of management may influence safety in different ways. For any intervention of an organization's safety policy and outcomes, management's commitment and actions towards safety are the key elements of success. Commitment affects attitude. Ultimately management's attitudes and behaviour in terms of safety influence many aspects of safety behavior.

In summary, based on a general review of the safety culture and safety climate literature, it appears that developing a more human resource-based working environment, or 'people-oriented culture', may be one of the most important elements for ensuring safety success.

(5) Performance perspectives

In the early days of safety we used accident measures (e.g. number of accidents, frequent rates, severity rates, costs, and so forth) to indicate safety performance. In those days we felt comfortable using those measures even though they did not help us much (Rose, 1994). However, they did not really tell us whether or not our system was working. They did not diagnose what was working and what was not. And they did not tell us if things were out of control. As Hopkins (1995, 1999) points out, lost time injury frequency rates (LTIFR) bears no direct relationship to injury frequency. His examination of accident data in the mining industry indicates that LTIFR data are far more indicative of changes in claiming behaviour than of changes in safety performance. Difficulties are also experienced when LTIFR is linked to reward systems (Hopkins, 1994; Shaw, 1992). The most serious of these is the tendency for under-reporting of injuries by workers who are paid incentives for long accident-free periods. Despite learning that accident measures were close to meaningless, we still find those somewhat ridiculous figures are still in use nowadays without supplementing them with indicators of a more positive nature.

At an international workshop on workplace safety, the thinking of adopting an reactive approach was also challenged by Dr. Frank Rose, of ICI(UK), who believes it to be fundamentally flawed:

"If we are in the business of promoting occupational safety and health, why do we use failures as the measure of our success?" (Rose, 1994)

There was a prolonged debate on the issues of performance indicators. Subsequently, safety professionals and researchers have identified an ongoing need for additional measures of safety performance (Kletz, 1993; NOHSC, 1994; Glendon & Booth, 1995; Shaw & Blewett, 1995).

Are accident data good for anything? Hopkins (1995, 1999), warns of the dangers of focusing on accident figures because safety performance can also be influenced by many factors other than accident statistics. When the limitations of basing our measures on accidents became
painfully obvious in the 1950s and 1960s, we created a different measure to assess safety system worth – the audit. We assumed that if we could indicate ahead of time what an organization should be doing to prevent accidents, then we could measure how well it was doing the predetermined things, something we have been doing that for more than 30 years. In this regard, Øien (2001) proposes more specifically an organizational factor framework from which organizational risk indicators can be established. The framework includes: organizational model, organizational indicators, and a quantification methodology. Using the proposed model as a qualitative tool, he claims that it can facilitate the finding of root causes of accidents, independent on any quantification of impact on risk.

As the audit concept gained acceptance, the idea of the packaged audit became popular. Perhaps starting in Canada with the book “Total Loss Control” by Jack Fletcher (1972), the concept evolved rapidly and was widely accepted throughout the world. Examples of the packaged audit are the SafetyMap of Australia, the NOSA system of South Africa, the British Safety Council System, and the ILCI Five-star program.

The whole concept of the packaged audit implies that there are certain defined elements that must be included in a safety system to get a high rating or greatest number of stars. In doing this, the audit suggests that certain specific elements are essential and thus are included in it. But how consistent and effective are such systems?

A NIOSH study in 1978 identified seven key elements needed for safety performance (Cohen, Smith & Cohen, 1978). Most are not included in the above packaged programs. The four most important components for safety success in study of Cohen et al. were:

1. Top management commitment
2. A humanistic approach with workers
3. One-on-one contacts
4. Use of positive reinforcements

When comparing these key elements with those recommended in the packaged audits, significant differences can be found. Only “item 1” in the list of Cohen et al. is included in the above-mentioned audit packages. The other three are largely ignored. Furthermore, a Michigan State study suggests similar results (Shafai-Sahrai, 1973). A major study done by the Association of American Railroads conclusively shows that the elements in most packaged programs had no correlation with bottom-line results. A National Safety Council study also suggests that many of the required elements of packaged programs were quite suspect in terms of effectiveness (Planek and Flain, 1993).
Clearly the validity of the concept of accepting audits as a safety performance measure is skeptical unless these audits have passed some rigorous validity tests.

**Research on safety performance**

Research on effectiveness of safety and health intervention programs is varied in approach, target, goal and hypothesis. Researchers have evaluated cost effectiveness and qualitative aspects (Simard & Marchand, 1994) and used statistical approaches to articulate meaningful data and results that show the effectiveness on safety performance or intervention effectiveness (Haure, 1983). Research on single interventions that focus on both reduction in unsafe behavior and reduction in injuries has been producing significant results. Combined studies, such as the integration of literature pertaining to individual, micro organizational, and macro organizational influences on safety (Hofmann, Jacobs & Landy, 1995), have informed researchers of the need to adopt a combined or an integrative approach.

There have been numerous attempts to isolate specific safety management practices that predict safety performance, the results of which has led to the development of audit tools for ensuring safety management practices (Hurst et al., 1996; Hudson et al., 1994 and Mitchison & Papadakis, 1999). Some of the earliest studies, however, identified common features of companies with high safety performance, but failed to include control companies with low performance.

Traditionally, as a standard management practice, many organizations have used outcome measures of performance to monitor their safety performance. In order to measure the success of an enterprise's safety performance, performance indicators have been developed for specific areas that are to be monitored. The NSW Health Department (1998) defines performance indicators as "a statistic or other unit of information which reflect directly or indirectly, the extent to which an anticipated outcome is achieved, or the quality of processes leading to that outcome" (p3). However, loss time injury frequency rates (LTIFR) has long been regarded as the standard for the primary measurement of safety performance. It was designated in the Australian Standard 1885.1-1990 (Australian Standard, 1990) and has been adopted throughout the world as the standard indicator of safety performance.

Although the validity of assessment is always a major concern, the opportunity of developing positive performance indicators has never been better as the result of the fundamental changes of thinking on having an integrated set of performance indicators for more reliable measurement of safety success. "The cases (both positive and negative) need to be developed as a model of safety best practice that can be empirically tested to provide some evidence of causality between safety best practice and positive performance outcomes." (NOHSC, 1994)
In sum, many measurement techniques such as audits, perception surveys and cost benefit analysis have been used to measure safety performance. The studies that define qualities of successful programs play a valuable role for practitioners to understand what are the safety objectives, intended outcomes, and how to use meaningful performance indicators to guide their effort in managing safety at work. It is believed that effective performance measures would focus on the management of safety in an organization and highlight strategic issues, priorities and areas of constraint. At operation level, effective measures could provide useful guidance by which systems problems and procedures could be addressed.

The meeting of perspectives

Perspectives meet at some points. Research that frequently includes an ethnographic component permits the roles of technological development, of symbolic meanings, of workplace organization, human factors and of competence to be perceived (Riemer, 1979; Fitzpatrick, 1980; Grunberg, 1983; Carson, 1982; Dwyer, 1983). Some take diverse views but the tendency is towards an integrated whole putting together the various perspectives presented above. The study of high-risk systems, a traditional domain of safety expertise, has become a major focus of research and reflection by various disciplines in the 1980s. And, towards the end of the last century, organizational and cognitive psychologists, ergonomists, sociologists, and management scientists introduced diverse perspective in their research.


In ”Beyond Mechanization”, Hirschorn (1984) has dedicated considerable effort to examining practices in postindustrial work and develops arguments as to whether highly complex industries can function safely without taking into account the workers, their perceptions and behaviours. He points out that human skills and judgments are needed now more than ever to effectively run today’s complex production systems. With numerous examples he shows that emerging technologies can fail unexpectedly and that human judgments have become increasingly important. Reflecting on “Three Mile Island” and other nuclear reactor incidents, Hirschorn perceived that human control of these technologies is important. In such processes, he proposes that:
“Workers must be able to form an integrated vision of what goes on in their area and have the
capacity to engage in corrective action ... New technologies ... demand that we develop a culture
of learning, an appreciation of emergent phenomena, and understanding of tacit knowledge, a
feeling for interpersonal processes, and an appreciation of our organizational design choices”
(Hirschorn 1984).

Hirschorn (1984) proposes that workers must be able to form an integrated vision of what goes
on in their area, and have the capacity to take corrective action. Workers need to be able "to
understand the consequences of their control decisions." However, for this to happen, a whole
set of new considerations need to be integrated into the design of workplaces. While Hirschhorn
was quite precise in specifying in 1984 that the form of integration between the technological
and social system is of major importance, Reason provides a broader view that organizational
factors, like the culture or work climate, are viewed as latent risk factors of management
concerns (Reason, 1997).

The evolution of organizational and cultural theories about the causes of work accidents,
as suggested for example by the work of Hirschorn (1984) and Reason (1997), reveals a shift in
causal factors of occupational accidents and illnesses. Among the primary factors, a specific
mode of organization in terms of preventive programs is also frequently mentioned (Andersson,
1999; and Asphal, 1999). Among these programs, the adoption of voluntary measures of
prevention is often considered as a key factor. From a system point of view, prevention now
involves developing knowledge of the risks inherent in each system component, thereby making
it possible for management to take adequate individual, organizational and technological
decisions. This viewpoint is in line with my working definition of a “safety management system”.
But it has failed to address the capability development issue because of most authors were
interested in the “ends” (e.g. the safety performance) rather than the “means”.

### 3.7 Safety management as an emergent strategic issue

“There is nothing more difficult to take in hand, more perilous to conduct or more uncertain in its
success than to take the lead in the introduction of a new order of things.” – Niccolo Machiavelli

Workplace safety as a function of strategic management is a relatively new concept that is still
searching for acceptance by organizations. This conception challenges our thinking about
resource and capability implications. In this, history matters a great deal. Past research
experiences, education and training, decision-making, strategic choices and subsequent
management actions will all have determined the inherent capabilities and human resources that
a company has accumulated. A portfolio of capability edge is largely determined by earlier
strategic choices. In the same way, current decisions and strategic planning may be seen as
preparing for future development needs. This proactive approach gives today’s strategic choices
a much greater impact on the future than many conservative managers can appreciate. The strategic development approach has positive implications because critical capabilities that enable organizations to develop capability edge and competitive advantages over time. The niche often resides in the organizational memory, based on knowledge and capability developed through strategic forward thinking and strategic planning.

History is a memory of the current state and critical happenings that will have significant impacts on or implications to our future. Risk is a terrible thing to ignore. It may threaten the continuity of a business because sometimes small things may lead to enormous consequences. Therefore, implementing an effective and lasting process of capability development is a strategy to create a promising future ‘free’ from preventable losses.

**Safety management as a strategy**

A strategy is “the science of military command, or the science of projecting campaigns and directing great military movements; generalship” (Webster’s 1913 Dictionary), or “an elaborate and systematic plan of action” (Hyperdictionary). In business context, strategy is closely related to a long term plan of action designed to achieve a particular goal. Strategies describe critical actions aimed at improving the strength of an organization in relation to its present position.

The organization capability are defined by it projects, resources and culture. According to Johnson and Scholes (2001), strategy is defined as follows:

“Strategy is the direction and scope of an organization over the long-term: which achieves advantage for the organization through its configuration of resources with a challenging environment, to meet the needs of markets and to fulfill stakeholder expectation”.

“Strategic management” is a managerial function that helps corporations identify, analyze, and respond to social, ethical and political concerns that can significantly affect them (Scholes, 2001). The basic elements of a strategy for an enterprise are – the accomplishment of a particular goal. These elements, including stakeholders, organizational capability and capacity, are influenced by social, political, economic, demographic and scientific driving forces for change.

Strategy is, we have seen, most noted by its absence. This was especially evident in large organizations in which economic factors, such as profits, productivities, efficiency, etc., take priority over other ‘non-profit making’ activities. In the absence of an appropriate strategy, premature closure leads to a repeated failure when a process or program is terminated before its successful completion has matured. Development of safety capability represents a strategic issue because, internally, it is a systemic problem and, externally, the safety obligations are mandated by law. For high-hazard industries and some of the organizations, safety, undoubtedly, is a
strategic issue of management because complexity, legal, social and ethical commitments, business continuity, and long term strategic planning are implicated.

3.8 The challenges

In managing safety, the major challenges are associated with uncertainty, complexity and systemic problems. James Reason’s Human Error Model (or Swiss Cheese Model) teaches us that, in reality, no system or human within-the-system is perfect (Reason, 2000). How do we face this kind of uncertain, complex, or systemic problems? What do organizations, managers or practitioners need most in developing their capability to deal with these safety management issues, which are not only externally imposed but something of an intrinsic nature within an organization? The evaluation report on the 1998 Longford explosion by James Nicol (2001) rightly point out that:

“The Longford disaster highlighted how a combination of ineffective management procedures, staffing oversights, communication problems, inadequate hazard assessment and training shortfalls combined to result in a major plant upset with consequential tragic loss of life.”

In examining safety management issues from different perspectives, all critical factors – goal-setting, strategies, capabilities, etc - appear to play important roles in the future of the safety profession although not specifically discussed in previous research. However, the situation is being continuously transformed by forces that push us in new but challenging directions. From a research point of view, crucial developments could well occur were the nature of those unintended motivations of the professional's interventions subject to systematic analysis that sought to link technological, organizational and sociological knowledge, as well individual and organizational capability in dealing with safety issues of our workplace.

Apparently, from this review, “capability” is an area seldom addressed in any breath and depth. Capability development has a long historical root but it has never been explored or seriously considered in the field of occupational safety and health.

3.9 Chapter summary and discussion

Despite safety being a basic human need, accidents and tragedies has never been reduced by people, who do not see enhancing safety is a social as well as an ethical responsibility. Safety management regulation by law, however, helps ensure that everybody understands how workplace safety is supposed to be dealt with on a self-regulatory basis. New safety management standards help organizations focus on maintaining the well-being of people at work that are “beyond compliance.” Instead of focusing on inputs, they are focusing on outcomes that are meaningful to the people. It takes time and capability to put them together. These new
regulations and system approaches are useful, and system integration is important. But the real work of a safe organization is much simpler if everybody concerned is equipped with appropriate capabilities in response to the dynamic, complex environment.

In this chapter it has been demonstrated that workplace safety and safety management is not necessarily new, although there is a contemporary enthusiasm for more appropriate stewardship of workplace safety, human and organizational resources. My working definition of SMS is: “A safety management system is a systematic development and application of a combined set of technical, social, managerial functions and organizational capabilities, which can reduce the probability and/or consequences of potential hazards in a specific working environment.”

Furthermore, SMS is a strategic management issue involving externally-imposed obligations and therefore it can affect how the rules and resources are managed. External influence of social pressure and government interventions, with the potential to shut down an organization or operation, has made the safety issue obligatory. With the urgency created by the obligatory nature of the issue and the external influence, internal confrontations will likely occur regarding implementation of related policy. The problem for organizations involves engaging in work-place discourse that resolves internal confrontations regarding workplace safety issues so that they can be appropriately dealt with and responded to in the organization.

The study of high-risk systems, a traditional domain of safety expertise, has become a major focus of research and reflection by various disciplines from a social, technological, organizational, cultural, behavioural, or performance perspective. Hence, there is a body of highly specialized knowledge about safety or risk management in broader society, but there appears to be no material relating to how safety managerial capability should be developed. Nevertheless, perspectives meet at some points. Some take diverse views, but the tendency is towards an integrated whole putting together the various perspectives. But, the “good” intention has made safety management far from lean or manageable. If this situation continues, I believe we are in danger of being all dressed up but nowhere to go.

Where are we going, and what has to be developed? What capabilities are more critical than others? And, how is capability maturity measured? These are the searching questions, the answers to which remain uncertain. Hence, the outcome of a study that examines the discourse of capability development and its evaluation will fill the gap in the literature. Intuitively, because of the dynamic and complex nature of work, it has been suggested that, besides adhering to the legal mandates, a new perspective of capability approach and a framework for analyzing and studying practitioners’ discursive action and their self-efficacy belief is indeed necessary. More justifications for this claim can be found in the following chapters.
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Chapter 4: Building Critical Capabilities for leveraging human potential

4.1 Introduction

In response to the problems highlighted in the previous chapters, “capability building and development” is suggested as a strategy to account for the complexity of workplace safety. The message is that capability development can be modeled in terms of interacting processes obeying a few simple rules. These processes are also needed to account for the uncertainty of risk, particularly in dealing with safety issues in the workplaces.

Capability building, as a meta-level capability (Rastogi, 2000) of an organization, plays an important role in the capability development process. Based on strategic choice, acquired capabilities can inform other learning and capacity building activities. In other words within the proposed ‘capability approach’, there is a central role for the diffusion of knowledge and active links operating through the realization, shaping and changing of learning patterns, transmission of knowledge and sharing of experience and expertise.

Using safety management as an example, the significance of capability development is assessed against its core purpose and meanings to illustrate how an inventory of critical capabilities can be established. A process of meta-analysis with reference to the relevant literature on safety management was undertaken to generate a set of Critical Capability Inventory. This inventory (and the method of deriving it) can be seen as part of my major research effort that addresses the evaluative aspect of the capability approach – one of the two central theses on which Amartya Sen’s “Capability Approach” were based (Sen, 2000).

4.2 On the nature of “Capability”

Capability building and development can be conceived as an ever-changing process of human development which regularly realigns learning with strategic goals - a set of coherent moving targets for the betterment of human well-being. Capability building and capability development are mutually inclusive. For the sake of brevity, I use the term “capability development” to
represent the process of building capability from an unfocussed state to something of strategic nature with sustainability.

**What is capability and is it useful to distinguish it from capacity?**

How do we define capability and the associated terms is important for our understanding of underlying concept of capability development? Amartya Sen (1987a) defines that “*a functioning is an achievement, whereas a capability is the ability to achieve.*” (Sen 1987a: 36) From a social learning perspective, capabilities account for the abilities of an individual to achieve different desirable combinations of functionings and goals. Literally, we can understand ability as the quality or state of being able; or potential to perform, whether physical, moral, intellectual, conventional, or legal; or having the skill or competence in doing (Webster's 1913).

The Webster’s 1913 Dictionary also defines “*capability*” as “*the quality of being capable, or capacity of being used or improved*”; whereas “*capacity*” is “*the power of receiving or containing; extent of room or space; passive power – used in reference to the physical things.*” To make better sense of their meaning, it would be useful to distinguish capability from capacity using a metaphor of the “dam”.

Think of a water dam whose purpose is to catch and store water for irrigation purposes. The capacity for irrigating the land is stored in the reservoir that the dam has built. The higher the dam it is the more capacity the reservoir has for irrigation of the land. However, the ability to irrigate successfully depends more on the storage of water. It also depends on other factors - climatic conditions, rainfall, the presence of something to control the water supply downstream, the quality of the water distribution networks, etc. All these affect the capability of the dam to achieve its objectives and functionings besides the size of the dam.

So it is with capability building. All the skills, knowledge, expertise and experience in the world won't help if the capability of the program, organization, community or environment cannot sustain and nurture those skills and abilities for developing potentials.

By thinking of the dam as a metaphor, what we can see is capacity building (visualized as building large dams and reservoirs) without a great deal of capability building (the ways of getting adequate water at the appropriate time). If this situation continues, I believe we are in
danger of being all dressed up and nowhere to go. Or, like the Concods, we are going to a party where no one’s still alive.

**Why do I say this?**

Understanding capability and its development is about getting away from the "if we build it, they will come" syndrome (Cheyunski & Millard, 1998). Like a “water dam”, it is about what the capacity that an organization or its employees should have, and the capabilities it should provide in order to achieve and thrive in the future.

To give a meaningful answer to what capability means, my primary assertion stemming from the metaphor is that people must attend to the relationship between their local actions and environment as a whole. Thus the tasks I have set for myself in this chapter are: (1) to discuss the possible meaning of the many important pieces of literature about capability – its definitions and implications in relation to my study on capability using safety management as an example, and (2) to report the findings of my meta-analysis study.

### 4.3 Meanings of capability development

Let’s go back to the basic idea of capability. As ‘capability’ is the umbrella concept for this study it is important to go deeper into this concept, as its different interpretations enable a better understanding of my position upon which the rest of my work will be based.

Webster’s dictionary indicates that the noun can be explained in three ways:

1. **[plural]** Undeveloped abilities, features etc.; as a theme possessing great capabilities. (25)
2. The capacity of being used or developed. (26)
3. The quality of being capable or capableness. (27)

Explanations 1 and 2 indicate that ‘capability’ may be seen as something broader than only pure ‘skills’. As outlined below, I start from the ‘capability approach’ as advocated by Amartya Sen, which in a way is linked to explanation 1. The second meaning is then the capacity of a safety management technique to be used. For this a reference is made to Garnham’s concept of ‘technics’. Finally what is possibly the most common meaning of capabilities is mentioned in explanation 3. This latter interpretation is integrated with Mansell’s notion of capabilities.

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25 So that may be developed at a certain time
26 In the sense of e.g. capability of improvement (potentiality)
27 In the sense of e.g. capability of acting (ability)
First meaning: Social relevance

The first meaning of capabilities can best be illustrated by the reasoning of the Welfare theorist and Nobel Prize winner Amartya Sen about the well-being of individuals in the welfare state. According to Sen, a common indicator used in the assessment of well-being is the resources and income available to people. In welfare economics the indicator is the maximization of utility (Sen 1977, 1995). However, Sen criticizes both of these approaches. With its focus on the equality of resources, the first approach does not take into account people’s particular situation because people can have different natural endowments. The second approach refers to ‘welfare economics’ and to the principle of utilitarianism (28) that underlies the issues on mental experience of a person. As persons may adjust their expectations to their condition, this is also not a suitable guiding principle to measure the state of well-being. Because of these shortcomings Sen introduces the concept of ‘capability’ as an alternative approach, which is socially relevant and can be generalized in much wider context.

How does Sen define his “capability approach”? In essence he explains that if we start from a more normative view, we need to be concerned with entitlements. The idea behind is the assumption all people have entitlements to certain forms of welfare. Another question is, then, entitlements to what? According to Sen, one should not focus too much on income but instead on what he regards as the ‘space of functionings’. This is defined as the various things a person may value or enjoy doing. The focus can be either on the ‘realized functionings’ or on the set of available but desirable alternatives (Garnham, 1999: 113-115). The latter are defined by Garham as ‘capabilities’.

So the difference between a realized functioning and capability equals the distinction between a state of well-being and the achievement of a state of well-being. Hence capability, as opposed to functioning, is linked to the first meaning given by Webster’s dictionary: ‘undeveloped abilities or features’, for example, maintaining a healthy and safety working environment by effective management of risk can be a valued functioning as well as an entitlement of people at work. When this is not the case, it is important to look at the level of capabilities instead of just looking at what is missing. The fact might be that people are incapable of dealing with risk, or simply they are not properly trained. Some of them might not be aware of their safety entitlement, or the others might risk themselves by skipping the safety procedures because of their impersonal character or behavior. A lot of these may be concerned with a valued state influenced by people’s knowledge and capability. This valued state, however, can

28 Utilitarianism (from the Latin utilis, useful) is a theory of ethics based on quantitative maximisation of some good for society or humanity. -- Wikipedia, the free encyclopedia
only be chosen by someone who already has the knowledge and capability to deal with workplace hazards within their control.

So if we accept the principle that people are entitled to be reasonably safe as part of their well-being, we also need to look further than only the statistics of incidents or accidents. Although these kinds of indices do provide some indication of safety performance, these crude indicators do not really get to the heart of the matter. In matters of workplace safety, we therefore need to look not only at effectiveness, costs, profits, productivity and everything in financial terms but also at the availability of the social resources in terms of human capability that make things effective.

**Second meaning: Capability of managing safety at work**

To what extent do specific groups of people – for example safety practitioners or managers – have the capability of being acquired and used in a given situation? Arising from the latter formulation of the meaning, if we change our viewpoint from looking at people to looking at the risk, we arrive at the second meaning of capabilities, which is ‘the capacity of being used or developed’ to deal with risks and safety matters. From this perspective, a much broader but related theoretical concept is given by Garnham (2000). In his discussion of media as technologies he makes a distinction between ‘technology’ and ‘techniques’.

‘Technology is a technique embodied in a physical tool, whereas technics are the underlying institutional forms, cultural values, and socially developed skills which a technology expresses and within which technologies are developed and put to work.’ (Garnham, 2000: 72)

His thesis suggests that putting safety technologies (e.g. safeguarding of machinery, safety protective devices, circuit breakers, radiation detection/protection apparatus) to work and using them is not simple and straightforward, but is embedded institutionally, culturally and socially.

**Third meaning: Capability of people**

The third meaning of capability, ‘the quality of being capable or capableness’, gets our focus back to people at work. It is, I think, the one which is closest to the source of risk. The mainstream idea of the word ‘capability’ is used in the sense of people having the ‘competencies’, ‘skills’ or ‘abilities’ to understand and apply theories, principles or technologies in dealing with safety issues at work. In a broader sense this interpretation is linked to the notion of ‘capabilities’ as defined by Mansell. In drawing attention to the importance of human capability, she stresses that capabilities cannot be taken for granted in an inquiry into the social and economic implications (Mansell, 1996). The capabilities principle, as Mansell suggests, can be used to recognize that human beings are knowledgeable agents. Those capabilities arise from diverse
experiences and they are the result of substantial investments of time and other resources. In order to research and explain developments in the area of safety management, one must therefore consider people’s capability. In a more strict sense this refers to the acquisition, development and accumulation of skills by people in order to management safety at work within a certain societal and technological context, and therefore “critical capabilities” are primary abilities that merit a strategic focus of development to be identified as such in the context of a given scenario, situation, or mission.

4.4 The importance of capability development

We all have capabilities to a certain degree of sophistication but we never know which one offers the most to our lifetime success. The ingredients involve alignment of the environment, strategies, capabilities (Copacino, 1999) with the strategic goals.

An organization’s performance depends on its ability to provide the necessary capabilities for individuals to take effective action. Sustainable performance is, however, beyond immediate reach but based on the quality as well as the organization’s ability to develop future capabilities within its mission. In the context of occupational safety, the making of strategic choice in regard to ‘what to develop’ seems most relevant from the viewpoint of integrating the traditional preventive safety strategy into a broader context of risk governance.

Capabilities are one of the essential precursors to sustainable performance (Saint-Onge & Wallace, 2002). They represent the link between strategies and performance. Focus of strategic capability development is to leverage the distinctive capabilities of the organization to achieve the desired state of well-being in alignment with the organization’s strategic goals. The most effective strategies are those, through collaborating, learning, and diffusing, create a critical mass of capabilities that ‘automatically’ generates other peripheral capabilities. According to Saint-Onge and Wallace, the value of capability building can be seen as a management strategy that promotes the following advantages:

(1) accelerates and leverage the creation of core capabilities,

(2) improves and enhances organizational learning,

(3) connects people into a network for greater flexibility and adaptability,

(4) shapes a “boundary-less” culture for greater synergy, and

(5) prevents knowledge loss from the organization through exchange of cross-discipline expertise.
4.5 What does ‘criticality’ mean in the context of capability development?

The concept of criticality

To understand the meaning of *critical capability*, it is necessary to clarify what ‘criticality’ means, especially in the context of capability development. Although it has multiple meanings, criticality provides a critical constructive intellectual counterpoint to mainstream management practices. To be critical, it has the strength of being sufficiently broad enough to serve as a source of critical reflection on a large number of central issues in management studies: epistemological issues, notions of rationality and progress, technological development, communicative action, *human resource development* (Alvesson & Willmott 1992: 11).

Criticality is often associated with structural changes in systems. The concept of criticality is an essential part of foresight since it helps to map out trends, issues and developments, including specific inventions, technological breakthroughs and methodological innovations that may need particular attention. It suggests that forms of rationality proposed by mainstream approach inhibit deeper reflection on means-ends relationship (ibid:11). In contrast, by adopting and applying the concept of criticality, we seek to encourage a questioning of taken-for-granted assumptions about social reality, for example, meeting legal requirements or externally-imposed obligations with double-bind unconsciousness (Stephenson 2002), a situation in which it is difficult to choose what to do because whatever we choose will have a negative result. For example, meeting new legislative requirements will have resource implications but, without additional resource, implementation of additional measures (e.g. risk management and control) may be met with some constraints.

Risk is a terrible thing to ignore! If an activity is highly critical and the damage resulting from possible negligence (or non-compliance) is enormous, it would be more advisable not to take it as something that would happen by chance but to build organizational capability and contingency around those particularly high risk areas. With capability development as a strategy, it would be possible for the organization to take self-regulating measures even during crises to ensure continuation of the business. Such a strategy of long-term preparedness and capability development make the organization capable of performing highly critical activities if these activities are by nature an indispensable part of the business. I would therefore regard this capability approach, in criticality, is a sort of *self-regulation* process. It is a “*new social order*” – a metaphor of seeking order from chaos.

In the discourse on self-organizing theory, many people hold the underlying assumption is often that what is really needed will indeed take place. Senge (1990) proposes the organization
as a complex nonlinear system directed by the vision of a charismatic leader who can control the system by identifying leverage points at which key interventions can be implemented. Thus, in managing safety at work using a systems approach, it can be assumed that developing a self-regulatory system will automatically lead to the diffusion of safety awareness and risk control. However, under normal circumstances, people are not aware of the “boiled frog” syndrome (discussed in Chapter 1, Section 1.3) when risks are subtly coming into play. Enormous consequences come into being when remedial action is too late.

**Criticality as a form of cultural chain reaction**

What is the role of criticality in cultural change? Metaphorically, Lillie (1986) explains that:

> “a piece of plutonium below the critical mass can be safely held in one's hand, but if two such pieces are suddenly put together and add up to a size above critical mass there will be an instant and enormous generation of energy. This is the basic principle of a nuclear bomb.”

Similarly, according to the “Critical Mass Theory” of Philip Ball (2004), one can see that a certain concept or a certain approach became critical as soon as a critical mass of responses, reactions, opinions or views was reached. Sometimes this kind of state is expressed as an “ism”, for example, constructivism (Newby, Stepich, Lehman & Russell, 1996), instrumentalism (McCarthy & Sears, 2000); pragmatism (Bredo, 1998), objectivism (Gotthelf, 2000), social realism\(^{29}\), etc. It can be seen that one or two opinions don’t mean much, except an eccentric theorist like Marx - a strength that has gained however from Marxism. Isolated efforts don’t mean much, except a genius like Einstein. But a critical mass of them becomes something completely different and critical. As such, I would think, ‘criticality’ becomes a form of a cultural chain reaction when collective thinking and behaviours become built up and turn into a critical mass. In other words I mean a critical mass of capabilities for empowering people with knowledge, increasing mental ability, expanding the human capability and powers of their individual intelligence. (See Chapter 2, concluding remark). In terms of capability development, I would refer ‘criticality’ to a critical mass of coherent capabilities essential for creating a chain of reaction that creates a future capability niche.

**Contingency principle of criticality**

Based on the above understanding of critical mass, my central assumption of the model that I’m going to suggest in the next chapter is that “competency and confidence” encourage more “competency and confidence” with mutual dependency and specifying effects. By taking on

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\(^{29}\) The American painters Ben Shahn, Leon Bibel, the Australian painter Noel Counihan and the Mexican painters José Clemente Orozco and Diego Rivera are all examples of Social Realists.
board this basic assumption, I mean leveraging effects and fruitful results become more likely the more we have a critical mass of capabilities acquired by the right people with right participation at an optimal level of confidence. This chain of reaction is contingent upon internal and external changes as well as resource limitations. And, this way of changing and becoming, in my view, is a contingency principle of criticality.

In contrast to criticality, what I would refer to is normality. Some refer normality to the environment and some say it is about culture. In the popular lexicon, for example, 'normality' has come to express a paradoxical meaning – a state of being normal. However, what is 'normal'? “The unlettered shrewd among us reply, 'nothing' - or at least, very little.” (Antony Black)(30). What was once unusual or unfortunate is now commonplace. What was commonplace is now taken for granted. What was safe will be taken for granted that the situation will continue to be safe. But, what is a normal, acceptable state? I would like to think of, at least in the case of safety management, as a basic “human functioning” or a “state of well-being”. The state of well-being is our medium of living. Our basic need is to be safe, and our entitlement at work is to become risk-free. However, if we image a state of work in which there is no risk at all, we are in fact saying that we, human beings, are flaw-free or error-free. It is unimaginable because freeing ourselves from human errors is against the law of human nature. This ideal state of error-free may, without involving a contradiction, have existed from absolute precautions. However, such an ideal would be absurd from a practical point of view. Doing away with human errors is impossible. But it represents the greatest challenge of our life. To overcome this inherent safety issue, capability building and development can be perceived as one of the substantial truths that help maintain a safety and healthy workplace to be enjoyed by all. But the process of development is contingent upon certain social factors and its surrounding environment.

In discussing “criticality” and “capability”, it appears that there is something in between to link up the concepts and come up with a completely new insight about “critical capabilities”.

4.6 What are critical capabilities?

As discussed earlier, a critical capability in general terms is a derivative of a capability composing of a set of building blocks - the core knowledge, skills and competencies. Building capabilities around a core set of building blocks, called “value streams”, is one of the key

30 Antony Black is a freelance writer concentrating, for the most part, on international issues from a ‘radical’ left perspective. Having incubated first in an intellectual context of psychology and psychiatric theory, then veered into the sciences, thence to writing and teaching. His contemporary writing about “Medicating Normality: The Psychiatric Colonization of Childhood” is available at URL: http://www.academyanalyticarts.org/black2.htm, Dec 2005.
enablers to link capability development with strategic planning. Alignment of existing capabilities with the strategic intent is at the heart of competitive success (Copacino, 1999).

“The central tenet in strategic management is that a match between environmental conditions and organizational capabilities and resources is critical to performance, and that a strategist’s job is to find or create this match” (Bourgeois, 1985: 548).

Strategic intent is therefore assumed to align with the environment. To find or to create are two very different undertakings. To find is to look for a match between the current demand and the current capabilities. On the other hand, to create a match, or fit, is to move one towards the other; to adjust capabilities to suit the demand, or to adjust the demand to suit the capabilities (Bourgeois, 1985).

In sum, the acquisition of critical capabilities involves strategic intent, critical learning and strategic planning for change. Thus, potentially, the development of critical capabilities helps us to do four things in order to adjust or realign our capabilities to cope with the future demand.

1. It helps us **strategize** more effectively, using the past to cope with future uncertainties;
2. It helps us **plan** more effectively, using past to cope with certainties;
3. It helps us **change** more responsively; and
4. It helps us **develop a process of meaningful development and learning**.

So what does the literature and research tell us about individuals, organizations and communities that are capable of developing and using skills that help us strategise, plan, change and develop meaning? What does it tell us about the kinds of organizations that are able to use the capacities they have stored up by those “water dams”.

**Ability to develop task-specific skills**

Our work provides opportunities for us to acquire, develop, and maintain lifelong skills as well as develop essential relationships in formal and informal ways. What essential properties are necessary for skill development?

We know from our experience that skill is a non-magical ability beyond the spell of words. The judgment of skill is implicit rather than explicit (Connolly, 1989). It differs from a spell not in how it is obtained but, in its basic nature, through deliberate practice (Ericsson, K.A., 1996), appropriate training/coaching (Singer & Janelle, 1999) and other psychological, social and cultural factors. Some researchers say effective skill acquisition has a lot to do with emotion, mental and cognitive state of the learner. For example, Morgan & Pollack (1977) have shown that successful athletes possess more positive mood states than their less successful counterparts (Vealey, 1992). Elite shooters exhibit different patterns of brain cortical activity than those less elite shooters (Boutcher, 1992). Research on human development also supports the relationship
between training/practice and skill acquisition. Moreover, previous research has identified
general rules that outline the transformation from novice to expert in a given domain area. These
include the "10-year rule" (Simon & Chase, 1973) and the “power law of practice” (Newell &
Rosenbloom, 1981). According to the “power law of practice”, Newell and Rosenbloom suggest
that the speed of performance of a task will improve as a power of the number of times that the
task is performed. And, according to the "10-year rule," a 10-year commitment to high levels of
training is the minimum requirement to reach the expert level.

Since then, there has been no significant evidence found to distinguish between experts
and novices on static or physical capabilities in relation to skill development. However,
consistent differences (e.g. for information-processing strategies) have been identified, thus
suggesting that these differences were the result of training or experience. Singer and Janelle
(1999) list the generalisable features that characterize the expert as follows:

(1) Experts have greater task-specific knowledge.
(2) Experts interpret greater meaning from available information.
(3) Experts store and access information more effectively.
(4) Experts can better detect and recognize structured patterns of play.
(5) Experts use situational probability data better.
(6) Experts make strategic decisions that are more appropriate.

In the context of capability development, the last feature is particularly important and relevant.

Ability to make strategic choices

A common question in the field of strategic management is how organizations achieve and
sustain competitive advantage or key organizational objectives. Prahalad and Hamel (1990)
argue that an organization should focus on developing core competencies that help it to create
enduring performance. Teece et al. (1997) extend this discussion of core competencies to
include capabilities. They argue that organizations should not be viewed as a portfolio of assets
but as a set of mechanisms by which capabilities are selected and built. The mechanisms, if to be
effective, involve strategic choices in making decisions.

Strategic choice is part of the decision-making process guided by goals and objectives as
well as a clear understanding of the critical functions. The "Strategic Choice Approach" is one of
several methods used in facilitating problem structuring and learning processes for individuals or
groups (Rosenhead 1989).

Drawing heavily on the work of Peter Senge (1990) and Hamel and Prahalad (1994),
Correale & Penco (1999) reflected over their experience in the area of “strategy and learning
"Visioning": formulation of the strategic vision together with appropriate staff participation.

Greater knowledge and improvements processes with a consequent re-dimensioning of the roles.

Widespread training and "bringing to the fore" people's knowledge.

Basic work on communication and mental models.

Co-operation and accountability among individuals and groups.

Increased incentives versus increased expectations: participation, a sense of belonging, loyalty and motivation.

To drive out of fear throughout the organization and the beginning of clear internal relationships (To me, it’s about “No-blame Culture” – see Chapter 2, Section 3 of this thesis).

In capability development, it can be seen from the work of Correale and Penco that the key issue in forming a strategy is the resolution of uncertainty through appropriate participation and widespread training.

Capability development involves goal-setting, strategic planning and decision making. The emphasis is on choosing our goals, objectives and processes of development in a strategic way, as well as focusing on the links between decisions with one another. It is a continuous process of choosing particular solutions strategically over time. Friend et al. (1974), drawing on the results of their research on strategic management, developed a methodology to facilitate complex decision-making processes involving strategic choice (Friend & Hickling 1987; 1997).

"The most distinctive feature of this approach is the way it helps users in making incremental progress toward decisions by focusing their attention on alternative ways of managing uncertainty” (Friend 1989: 121). “The approach sets out to do no more than to articulate, as clearly as possible, the kinds of dilemma that experienced decision-makers repeatedly face in the course of their work and the often intuitive judgments they make in choosing how to respond.” (Friend & Hickling 1997: 1).

With the "Strategic Choice" views, these management theorists help us understand the importance of strategic management. They point out that any strategic decision is attached to three broad types of uncertainty. These three categories of uncertainty are: “uncertainty pertaining to the working environment; uncertainty pertaining to guiding values; and uncertainty pertaining to related decision fields” (Friend & Hickling 1997: 9). Each uncertainty calls for a different type of response because no size fits all. The choice is contingent on our ability to change.
Ability to change

Strategic choice is one of the key agents for change. By adopting a view of *strategic choice* within the current research context, I mean strategies to manage safety must be framed and continually reframed with a dynamic and even more volatile environment in mind. This includes taking into consideration of people, timing and what essentially have to be achieved. This proposition of strategic choice is put up in view of and partly in response to the advancement of technology, and growing complexity and sophistication of our workplace. As such many workplaces have experienced significant and even accelerating change over the past 20 years (Bohle & Quinlan 2000:33). A number of the more important changes include, for example:

1. Changes to *work processes and technology* including increasing automation, use of computers and related information systems including changes in the physical environment.

2. Changes to chemicals and other substances present in the workplace.

3. Changes to organizational structures and work organization via *outsourcing, sub-contracting, downsizing, privatisation*, etc. and associated growth of precarious forms of employment such as leased staff, casuals and subcontractors. (Mayhew, Quinlan & Ferries 1997; Mayhew & Quinlan 1999)

4. Changes to the regulatory environment including safety & health laws and regulations.

All of these changes may have significant implications for safety and these entail a structural change to the way in which safety, risk and hazards are managed. If we go back to look at its history, the development of the methodology strategic choice (31) has been based on research at the Tavistock Institute for Human Relations in London in the 1960s, in particular, on the analysis of government policy-making (Friend 1989; Friend, Power & Yewlett, 1974). Their findings challenged the prevailing view of how strategic choice and policy-making are carried out. The same challenge arising from change is still there after four decades of research and development. For example, the recent work of Bob Doppelt (2003) is relevant as a challenge for changing our workplace into a sustainable, healthy and safe working environment. In his article “Overcoming the seven sustainability blunders” he proposes a new paradigm that he calls “the Wheel of Change”, with a set of capability development principles that help lead our way toward sustainability by changing the traditional paradigms.

1. Change the dominant *mindset*

2. Re-arranging the parts by organizing *teams*

3. Change the goals by crafting an ideal *vision and guiding principles*

31 The strategic choice approach is an analytical perspective, based on individual choice models, that focuses on strategies for shaping the context of decision-making (Collier & Norden 1991)
(4) Restructure the rules of engagement by adopting new strategies
(5) Shift information flows by tirelessly communicating the need, vision and strategies
(6) Correct feedback loops by encouraging and rewarding learning and innovation
(7) Adjust the parameters by aligning systems and structures

Ability to find meanings that promote critical learning

To believe in capability building is to believe in the butterfly effect metaphor (see Chapter 2), that a single individual’s simplest gesture has the potential and capability to cause significant change. No perturbation is too small to be of influence (Ekeland, 1988). In contrast, it raises the value as well as the status of learning – for example, being strategic and critical.

Consider the different ways people define what it means to learning in a critical way. For some, critical learning, thinking and reflection are represented by the use of lateral, divergent thinking strategies or double loop learning methods (Argyris & Schön 1978). The assertion in the context of safety management is that people learn critically and selectively when they examine the assumptions that govern risk-related decisions. These assumptions are grounded in an accurately assessed view of organizational realities.

What are the features of organizations that promote the appropriate development of meaning and learning? In my teaching and training experience, I have found that we can learn in matters of safety through four main cognitive activities – patterning, reflecting, puzzling, and strategic learning. My belief is that if we see capability development as a learning process, then the organization needs to permit these four types of cognitive activities to become a kind of strategic capability development process for making effective changes. In other words the organization needs to be able to acknowledge what has happened before and detect its relevance to the future.

(1) Patterning: Pattern governs our lives because pattern is routine. All of us have a “Nine to Five” working pattern that differs from our weekend pattern. For example, sleep, eat, dress, play, work, etc. We all have experienced pattern in our daily life or work. For example, we check safety devices and protective measures before pressing the ‘Start’ button, and we clean up the place, taking daily stock, filing production report before ending the day. There are seemingly endless things (e.g. the way we eat and the way we walk and talk) that represent certain patterns or ways of doing things. How does pattern enter into our life? Do we use patterning in any way to learn about our environments? Do we have any sense of how patterns might relate to our own safety? These questions prompt us to think about “patterning” as a way of learning.
(2) Reflecting: “Learning by reflecting” occurs when organizations or individual members learn how to make reflection on our learning. In their “double-loop learning” approach, Argyris & Schön (1978: 2) identifies two dimensions to learning in professional context. Firstly, in a simple form, “single-loop learning” involves working out how to perform a task better in a given context and with given scope. The second is “double-loop learning” involving critical reflection about the premises, and thereby possibilities of changing the processes and conditions under which the tasks are performed. Schön’s model of the reflective practitioner emphasizes this second type. (See also Chapter 5)

(2) Strategic learning is defined as “the process by which an organization makes sense of its environment in ways that broaden the range of objectives it can pursue or the range of resources and actions available to it for processing these objectives.” (Mason, 1993: 843). Learning is useful but not always strategic or really focused on finding meanings. There are too many people claiming that their training is strategic rather than tactical. However, not all training is strategic and capability-based. They are just “tactical”, just-in-time to keep the organization running instead of meeting long-term strategic goals. A strategic plan ought to be available to guide the development efforts. Otherwise, it will end up in nowhere.

(3) Puzzling is a bit trickier, since it requires people (e.g. comprehensive learners) to acknowledge and gain meaning from exceptions, contradictions, odd situations and things that are just simply missing. Sometimes, the art of puzzling involves the ability to see the unseen. In understanding a puzzling idea, people let their imagination wander freely to begin with, even if they do not seem to be much nearer a solution. In my own experience, organizations are quite resistant to some elements of patterning, reflection and puzzling, especially when they challenge the organization’s mainstream perspectives or values.

4.7 Developing organizational capabilities

Organizational competence is defined as “the firm’s ability to mobilize its organization, combining people of different skills to work together” (Miyazaki, 1994: 19, 24). These are the resource-based views concerning competencies and capabilities. Albeit rather inconsistent with a lack of general agreement, they emphasize the role of capability in determining performance. Resource-based theories help contend that organizations compete or become successful through effective control unique and inimitable resources. For the sake of simplicity and ease of

32 Comprehensive learners: learners who are often set off on long chains of independent and sometimes only tenuously related thought by ideas in books. (Leong, L.P., 2002)
understanding, critical capabilities can be addressed by relating them to two basic levels within an organization (Hamel & Prahalad 1994; Holmes & Joyce 1993; Spencer & Spencer 1993):

1. Individual Level: critical capabilities at individual level are contingent upon the particular needs and allocated resources commensurate with the nature and requirements of a specific job; and

2. Organization Level: critical capabilities at this level are the collection of knowledge, skills, abilities and other characteristics of an organization as a whole that represent the organization’s strengths.

Definitions of “Organizational Capability”

Definitions of ‘organizational capability’ vary according to discipline. They change over time and depend on the context in which they were defined. Noticing the impact of individual decisions on organizations is more worthwhile than trying to understand the behavior of individuals. Philip Ball writes in the conclusion of his epilogue that:

“A push and a pull; tension between conflicting desires. This is all it takes to tip our social behaviour into complex and often unpredictable patterns, dictated by influences beyond our immediate experience or our ability to control. Regardless of what we believe about motivations of individual behavior, once we become part of a group we cannot be sure what to expect.” (Ball, 2004: 469).

Ball’s (2004) conclusion implicates that, instead of looking for a definition of individual capability, it makes better sense to examine what capability means in an organizational context.

In management context, the notion of organizational capabilities has been developed within the resource-based view of the firm. Wright & Snell (1998) defines capabilities as “fit” to the current strategies. A capability is defined by Maritan (2001) as “a firm's capacity to deploy its assets, tangible or intangible, to perform a task or activity to improve performance.” According to Hitt, Bierman, Shimizu and Kochhar (2001), intangible assets such as human capabilities are more likely than tangible ones to add value and produce a competitive advantage. In terms of total quality management, Bowden (2000) sees a fundamental need to ensure an alignment between stakeholder needs and an organizational capability to deliver those needs. Specifically, for marketing, capabilities can be seen as “complex bundles of skills and accumulated knowledge, exercised through organizational processes, that enable firms to coordinate activities and make use of their assets” (Schoham & Fiegenbaum, 1999) citing (Day, 1994:38).
Capability development as a social learning process

Capability development is inherent in all human activities. It is a function of activities, working context and organizational culture. It involves social learning, which is sometimes informal (e.g. workplace-based). Bandura (1977) states:

"Learning would be exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them what to do. Fortunately, most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action." (ibid: 22).

Similarly, Lave and Wenger (1991) considers learning as situational and dependent on the interactions between people and their environment. Social interaction is critical for learning, which is often unintentional rather than deliberate. It is through social learning that we develop our capability individually and collectively in a different context. This transformation of oneself through social and situated learning is particularly important for the development of capabilities.

In order to understand better the nature of social learning in organizations an extensive review of the literature was undertaken by Cairns (1998). This review was based on two basic assumptions:

(1) Organizations, amongst other things, are primarily, social entities.

(2) Learning is a socially constructed concept that refers to the process of building meaning by individuals and organizations over time, and by experience in interaction with other within the learning community.

The review of Cairns suggests that learning, in the context of organizational capability, would exist when members see their learning linked to improved performance for the organization, perceive they have a role in their own learning, identify with the organization’s vision and goals, and value learning as capability development which would add value to their competitive advantage or organization success.

Capability is not attained automatically as a function of experience. It requires deliberate efforts to learn in a social context. Collectively, knowledge, skills, competencies and abilities become valuable capability sets useful through effective learning for achieving intended outcomes or the identified goals. Glaser (1966) points out that the maximal level of human performance is not attained automatically as a function of extended experience, but the level of performance can be increased by highly experienced individuals as a result of their deliberate efforts to improve themselves. To attain changes in behavior, attention is therefore needed to generate the desired action. For effective learning to take place, it is necessary to monitor the learning processes and performance in order to determine necessary adjustments and corrections.
At activity level, our learning is situated and supported by expectations, reasoning, planning, doing, and subsequent feedback. "We are conditioned to see life as a series of events, and for every event, we think there is one obvious cause" (Senge, 1990: 21). But, unfortunately, the actual causes of the problems (e.g. accidents) are not always obvious. Sometimes they are not directly linked with events. Some of them could be hard to predict. Some might be given rise from slow, gradual processes that are sometimes too complex to explain. Instead of doing firefighting or dealing with problems in isolation, there must be mechanisms that support expectation, reasoning, planning in order to generate feedback and effective error diagnosis with appropriate correction (Glaser, 1996).

4.8 Capability building for management of safety

What are the ingredients and processes that enable a critical mass of capabilities to be formed? How does it emerge from a morass of individual interactions, for example, in the specific context of capability building? Are there laws of nature that guide human capability development? Is anything inevitable about the ways humans excel themselves through capability development, or do we have complete freedom in shaping our destiny, for example, in matter of safety? How does strategic management come into play? In short, just how does one capability lead to another?

In searching for answers, I argue that we can enlist help from a seemingly unlikely source: physics – for example, Newton’s Second Law of Motion proposed by Newton (1643-1727). With the analogy suggested by Newton’s Second Law, I’ll discuss in the following sections the mutual dependency between critical capabilities as the essential ingredients of capability development.

Why creating a critical mass of capabilities is important

A critical mass of safety management capabilities is an interactive driving force that architects solutions to help organizations increase safety effectiveness in the long run. A concentration of attention to the identification and development critical capabilities, tightly integrated with individual and organizational goals, matters ultimately in packing a powerful winning force. In other words, having a critical mass of superior capabilities ensures greater operational flexibility and sustainability for meeting the conventional and unconventional challenges of contemporary and future safety needs; a point especially salient for small organizations formulating safety management strategies or policies in milieu of increasingly lean manpower resources and budget constraints.
Most of us learn from Newtonian physics that the intensity of force is derived from mass multiplied by acceleration (i.e. \( \text{Force} = \text{Mass} \times \text{Acceleration} \)). In the field of Newtonian physics, the amount of power (force) derived from mass multiplied by acceleration (speed). When we analogously apply the logic of physics into the field management strategy, there appears to be a tendency for people concerned to assert that level of capability (or driving force) of an organization help accelerate the speed of development (acceleration). This analogy may also be found in the walk of our life which is full of uncertainties. Specifically, in the ambiguous setting of risk uncertainty, it may be one thing to assert success of capability development if persistent efforts could be made and appropriate driving force could be applied with optimum speed (i.e. acceleration – change of speed over time), whereas the momentum are enabled by a critical mass of essential knowledge and skills with high fidelity of proactiveness. However, the sharp focus on profits and effectiveness should not blindside the need to maintain a sustainable, powerful critical mass of capabilities. After all, mass and speed, capability and proactiveness, are not mutually exclusive attributes. This is especially true for small organizations with little management strategic depth and their relatively small workforce.

From an operational perspective, small organizations can not afford to trade development space in order to buy time in matters of safety. For such states, maintaining a lean and sufficiently focus on high-hazard areas provides viable, realistic short-term solutions before accelerating speed is taken off the ground. With fiscal constraints imposed by shrinking budgets, draining an already limited pool of human resource, the real challenge for increasingly lean safety management systems and operations is how to boost capabilities to meet the future threats arising from risk, while retaining the core capabilities to meet changing business goals.

From an evaluation perspective, measuring capability maturity is difficult, if not impossible. There is no magic number to what constitutes critical mass for a safety-capable workforce, except I would hazard a possible broad definition –

\[ \text{It is the optimum mass of safety capability necessary for ensuring both the well-being of people at work, and, at the same time, protecting the interests of an organization in meeting its ever-changing business goals, backed by sufficient capability development structure and space.} \]

The definition suggests that the challenge of ensuring critical mass of critical capabilities is a moving target, dependent on organizational mission demands, external threats and social obligations. Thus, regardless of how organizations tweaks its order of business to deal with occupational risks, or how it chooses to leverage on capabilities to augment its workforce, there will be a threshold below which a critical mass of capability to engage and sustain safe operations must not be compromised.
Together we can transform our workplace

I believe core capabilities, which are critical by themselves, are ‘talking’ silently to each other in a self-reflecting way. The awareness of these core elements begins to establish norms and common practices, and provides the links for understanding each other. These critical capabilities are often less sure of their standing in our journey of capability development and, therefore, I feel there is a need to establish their presence. Thus critical capabilities, as the essential connectors, must be more explicit in their ways of relating to each other. These elements or connectors are parts of a “whole”, a “network” or a “critical mass” of things with a high degree of cohesion.

The critical capabilities that have been acquired will have a certain unity and therefore some cohesion. Where there is cohesion, the analogy of ‘critical mass’ can be applied. These critical capabilities will become a certain number of critical masses or a joint service capability, which, by its driving force, movement and direction, govern or influence the rest. However, individually, none has the critical mass of capabilities needed to transform our workplace the way we would like. None has the capability to drive the development of safety management, even to meet the minimum requirements as stipulated by law. By learning and acting together, however, organizations or practitioners begin to have the critical mass necessary to make an impact, both on developing safety management in the right direction and on each organization’s safety bottom line.

By the phrase “critical mass of capability and movement”, I refer it unequivocally to the main bodies of the joint forces – people and a collective of critical capabilities. It is a major act of strategic judgment based on optimum choices to distinguish these critical masses in the workforce and to identify their effectiveness and influence. Strategic judgment induces cohesion of action. Based on the previous argument it can be inferred that although the degree of unity and cohesion is small at the beginning, the concept of ‘developing a critical mass of capabilities’ still applies. My proposition is that a place affected by risks or threats, be they high or low, no matter what the size, represent the sort of unity in which critical mass can be identified. It can be a critical mass of joint capability or a critical mass of workforce (e.g. a safety assurance team, a taskforce for managing safety oversights, or a safety department). In contrast with the positive factors it could be a critical mass of weaknesses or vulnerabilities. That is the place or issue where decision should be focused upon.

Identification of critical capabilities

In the process of identifying the critical capabilities, a set of dominant characteristics applies. Out of these characteristics a certain critical mass of capability develops. The task of identifying the critical capabilities is difficult. If safety of people at work is a problem that must be addressed
by people themselves, it is useful to think of one of the greatest problem solvers, Albert Einstein: “Problems cannot be solved at the same level of consciousness that created them.” The implication is that the one who create a problem can easily get caught in one’s own bias and limitations. The situation often calls for a different way of thinking. To see the best solution, it requires a new perspective and a change of consciousness to deal with the problem created by one’s self.

We often learn from experience but with preoccupation. Senge (1990) contends that, in terms of social learning, what we have learned is often deluded by our experience. He points out that the "most powerful learning comes from direct experience". He says "we each have a 'learning horizon,' a breadth of vision in time and space within which we assess our effectiveness. When our actions have consequences beyond our learning horizon, it becomes impossible to learn from direct experience" (ibid: 23). Usually we cannot provide insight into the issues and deal with the problems that we create ourselves, because most of our reactions and decisions involve factors beyond our direct experience. To get around this, we can break the problem into small parts and get solutions bit by bit. However the whole issue might become lost and out of context because some of the factors or elements are dealt with in isolation from each other.

Problem-solving is not fast-food science! As suggested by Albert Einstein and Peter Senge, one of the key premises is to open ourselves to new ways of thinking, to redefine and reframe the problems, and keep revising goals for alternate outcomes. It is a strategy based on our accumulated experiences and the others’, based on what is known and what is not yet known, and based on substantial efforts of searching and re-searching, thinking and re-thinking. It also means simply paying attention with concentration, deliberately challenging our strategic thinking, avoiding probabilistic biases, and focusing on developing the much needed critical capabilities for worthwhile goals. Thus, in this study, the use of meta-analysis approach is in fact influenced by this Einsteinism that says in effect that if our thinking created a problem we better look into the past and look for valid findings. The approach involves the statistical analysis of a large collection of analysis of results from individual studies for the purpose of integrating the findings (Glass, 1976).

Building safety management capabilities – a strategic capability development approach

Whereas strategic thinking and safety management in particular are risk-based, capability building and its development better matches with and adapts to the changing working environment. Our safety experience and common sense are instructive; no one can predict the next outrage or critical point to which accidents might happen. This uncertain and volatile
situation, coupled with the growing complexity of working environment and inherent risks, places a high premium on strategic development planning. The complex and dynamic workplace environment challenges our flexibility of development. Developing a sustainable, capable future workforce requires an improved method of human resource development that I call 'strategic capability development' (SCD).

The SCD that I propose in this thesis (see Chapter 6) is a conceptual framework that balances resources with desired critical capabilities from a resource-based or resourcist’s perspective. Its rigor is derived in large measure for Amartya Sen’s capability approach (Sen, 1985, 1993, 1994, 1996, 1999a). The most notable difference is the concept of strategic choice that covers the spectrum of critical strategic capabilities the safety practitioners might require for managing safety as a focus of development.

The key objectives of SCD are to ensure that safety personnel are suitably qualified for projected future challenges and create a critical mass of safety capabilities essential for long term safety success and sustainability. This places a special premium on capability development but it entails a strategic approach to better the training of safety personnel and to improve their safety knowledge and managerial capability. With focused attention on critical capabilities across the complete spectrum of an organization’s operations, one can raise the level of thinking from basic safety operations to looking at broader options of how the effective use of the SCD approach can sustain the required capability. From the stance of SCD, both individuals and organizations can leverage and maximize the use of resources in fulfilling their strategic safety goals.

In order to provide a systemic view of how effectiveness of safety management can be dealt with, a “Critical Capability List” is identified, using a technique of meta-analysis of literature, to provide an inclusive, systemic view of safety management. The list represents the basic but important safety functions that organizations are used as the organizing categories. The end result when utilizing this method is a critical process which falls into one of the classification of safety management processes identified in the meta-analysis.

4.9 Meta-analysis of literature: identification of critical capabilities

In order to identify the critical safety management capabilities, I used ‘meta-analysis’ as a method to formulate a casual, narrative discussion of research studies to make sense of the rapidly expanding literature in the areas of safety and related studies.

The purpose of this meta-analysis was to identify a set of critical safety management capabilities. The principle of my method was to seek evidence from the ‘accumulation’ of previous research findings. The primary outcome examined might differ between studies, yet
this meta-analysis sought to aggregate findings of relevant studies to some common end-point. Since the research studies were carried out in distinct settings, which may differ markedly between studies chosen for this analysis, there may be many other factors (e.g. nature of business, or industry in which a study was carried out) that contribute to the success or failure of safety management. Therefore, in using the method of meta-analysis by making reference to literature, I was cautious about the results from a particular trial or study that might be disregarded in favour of the combined result.

Meta-analysis is often seen as a method of accumulating results across a particular research domain (Hunter, Schmidt & Jackson, 1982). Meta-analysis is a research tradition that Gene Glass (1976) refers to “the analysis of analysis” – a method for integrating and summarizing the findings from a body of research. Meta-analysis, in Glass’s term, is the statistical analysis of a collection of individual studies.

Meta-analysis refers to the analysis of analyse … the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. (Glass, 1976: 3)

The term ‘meta-analysis’, coined by Glass (1976), refers to the synthesis of research findings of different studies by means of statistical techniques. Over the last 20 years, meta-analysis has become a standard tool in many experimental sciences, and it is now increasingly being used in many fields of research.

Meta-analysis is a retroductive strategy. By adopting such a strategy, it also means initial learning from previous research about how people made sense of the issues being studied. In arguing about the validity of the method, Blaikie (2000: 165) contends that ‘retroductive reasoning’ helps find solutions to a research problem. Notwithstanding its unreliable nature, ‘retroductive reasoning’ is considered to be an important kind of reasoning, because it is our reflection that opens up new grounds (Kehler, 1911)\(^{33}\). So retroduction comes first and it is the least complex kind of reasoning to start with as an effective way of seeking a common ground or making observations to identify the differences.

Hunter, Schmidt and Jackson (1982) succinctly explain the term ‘meta-analysis’ stating that meta-analysis is the ‘analysis of analyses’. In using the method, one should note that its statistical nature distinguishes the meta-analysis method from other types of summarizing techniques, such as state-of-the-art literature reviews. It is concerned with the statistical analysis of research results of studies performed previously, and is therefore distinct from primary and secondary analysis (Glass 1976). In using this method, one might be facing a difficult choice

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between two extremities. I can see that being too exhaustive in the literature survey would be unrealistic but too selective would lead to unreliable, biased conclusions. Therefore a practical way is to conduct a random sampling (e.g. using a multiple searching strategy) to ensure representativeness.

**What managerial capabilities do safety practitioners need?**

How do we identify and decide which capabilities are of critical importance to safety practitioners? To answer this, in addition to what has been elaborated in the chapter, I would add a further point proposed by Paula England: “a capability is a state (involving some combination of motivation, skill, and/or health) that requires some effort to develop, and that, when developed, enables one to function in ways that contribute to the well-being of oneself or others.” (England 1997). This broad notion in terms of safety management, however, could lead to an endless list of specific detailed capabilities – such as being able to formulate safety policy, synthesize and analyze safety/risk information, solve safety problems, design safety devices, conduct induction training, prepare safety manuals, write accident reports, facilitate safety committee meetings, carry out routine safety inspections, and resolve conflicts in matter of safety, to name a few. However, with such a long list, how do we resolve our safety priorities, for example?

The setting of priorities depends on our goals and our capability to make appropriate judgment. I think the claim that the critical capabilities produce utility or confidence for someone is quite uncontroversial. The leveraging effect of being critical is universal. Therefore, for the purpose here, I simply want to identify the critical capabilities that are relatively important and strategic. The strategy is to identify first of all the appropriate clusters or building blocks that provide a solid foundation or focus for other capabilities to develop. The benefit of this strategy is to skew results in favour of greater coverage.

While there might be debate on the issue of identification, I do claim that the approach provides a useful guidance through which a better or more precise list of critical capabilities can be produced on an ongoing basis taking into consideration of the changes and new findings in subsequent research.

**Identification of critical safety management capabilities**

The approach taken in this part of study was based upon reported observations and investigations of previous research. It was based on the premise that knowledge can be acquired from previous experience of other people, especially validated research outputs. The method involved careful and vigorous analysis of documentation of exactly what happened and what was observed in the recent past. One may find that the process of analysis might involve fairly complicated statistical
methods depending on the objective of the research. Here I approached the problem in a simple but most effective way because the main concern here is just to find out what are the most valuable processes or capabilities important for safety management success.

Objectives

Building a rich understanding of the situation by accepting that “what we see depends on where we look, where the light is, etc.” (O’Leary, 2004). A significant issue for this meta-analysis is the breadth and depth as well as the relevance of the literature on the subject, which is spread across several disciplines, for example, safety science, occupational safety and health, engineering, medicine, management, and almost every field in which safety is a major concern.

The purpose of this meta-analysis was to seek understanding and to summarize the findings of previous studies in safety management in order to identify the critical success factors or determinants of successful safety programs. The outcomes of this analysis become a set of critical safety functions from which a critical safety management capabilities list is drawn.

Method

In 1904, Karl Pearson conducted the first reported meta-analysis about the efficacy of a vaccine against enteric fever (Egger, et al., 2001). Although the general approach to the conduct of meta-analysis has been described (Dickersin, et al., 1994), most work has focused on statistical methods rather than data collection. Of those investigators who have examined methodological issues pertaining to data collection, most have relied solely on journals or reports on a particular field (e.g. Safety Science or Journal of Safety Research). To date, there still are no clear guidelines for formulating a search strategy, defining exclusion–inclusion criteria, reporting the results of a literature search, or determining sampling size and which electronic databases to search (Lemeshow, et al., 2005). To conduct an exhaustive search on a subject can be a nightmare in the past when libraries are the only source of information. The situation to date, however, has been improved considerably with the availability of powerful internet searching tools and world-wide electronic collection of journals and bibliographic information databases, such as the Citation Index and ScienceDirect.

To ensure appropriate representation of the findings, an intensive electronic search of four major online databases, covering journal articles and research reports published in the period of 1980 to June 2004, was performed. These databases were: Citation Index, ScienceDirect (34),

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34 Launched in 1997, ScienceDirect claims to be the world’s largest electronic collection of science, technology and medicine full text and bibliographic information.
BioMed Central, and Medline, supplemented by scanning contents pages of major safety journals such as Safety Science and Journal of Safety Research, together with the citations in any of the safety or related journal articles. However, unpublished reports were not sought. Thus it is possible that some relevant studies that have been completed are not included in this review, although I judge their likely impact on the conclusions to be minimal.

For the purposes of this research, journal articles from this literature were identified using the following criteria:

(1) Articles had to present substantive, well-specified, and empirical content focused upon workplace determinants of safety success;

(2) They had to have been published in peer-reviewed journals or in a monograph regularly cited by other authorities (e.g., Dawson, et al.,1988);

(3) Be published after 1980, except where they are regularly cited by other authorities.

The searches were restricted to the English language. Search terms for meta-analysis were “safety management”, “safety capabilities” and “safety performance”. System related studies were identified using search terms such as “safety management system”, “safety system optimization (or optimization)”, “system types”, “safety system design”, SMS, OHSMS, and OSHMS. Factor analysis or studies were identified using the terms “safety factors”, “safety determinants”, and “critical safety factors”. These key words were used in each database to identify the critical safety success factors cited in literature for the purpose of establishing the capabilities list.

**Findings and discussion**

By adopting the above search strategy, the searching of multiple electronic databases produced a return of some 280 substantive journal publications. Among these publications, 32 were found to meet all three criteria for inclusion in the meta-analysis.

Of the 32 publications identified (Table 4-1), seven (7) were published in the journal of Safety Science, six (6) were published in the Journal of Safety Research, four (4) were published in Reliability Engineering & System Safety, two (2) were published in the Journal of Loss Prevention in the Process Industries, and four (6) were published in other journals, such as International Journal of Industrial Ergonomics, the International Journal of Project Management, Journal of Construction Engineering and Management and Journal of Loss Prevention. Of the remainder, (7) were research reports, topical papers or other official safety publications (e.g. published by BSI, IAPA, NOHSC, and Rail Safety & Standards Board). The
study of these publications has generated both quantitative and qualitative data, and the results of which are summarized in Appendix 2.

**Representativeness of data**

These thirty two (32) publications were chosen based on their unique characteristics of having well-specified empirical content focusing on determinants of workplace safety. They were all published in peer-reviewed journals within the specified period. The rest of the two hundred and eighty (280), although they were sensitive to the keyword searches, they did not match well with the selection criteria specified for this study. For example, the 4-year longitudinal study of Cox, Jones and Rycraft (2004) about “*Behavioural approaches to safety management within UK reactor plants*”, suggests that “*BSP (behavioural safety process) is embedded at all levels and within all representative sites participating in the study. However, the issue of sustainability has been identified as a potential problem ...*” (Cox, et al. 2004: 825). Although the study was concerned with safety management, the findings did not lead to any specific conclusion that BSP is a determinant factor of safety management success. This journal article of Cox, et al. (i.e. one of the 280 publications) was sensitive to my keyword search, but it was rejected on the ground that the objective and content of the study did not match the criteria that I had set. Thus the work of Cox, et al. (2004) was not included in the final list for further analysis although their work is highly relevant and important for our understanding of safety management in the context of BSP.

Another example is the well known study conducted by Silva, Lima and Baptista (2004). The findings of their study about “*OSCI: an organizational and safety climate inventory*”, derived from data collected from a total of 930 workers in 15 industrial organizations, suggest that the results of their study support the reliability and predictive validity of their research instrument - OCSI (Organizational and Safety Climate Inventory). Their instrument, OCSI, allowed the characterization of both organizational and safety climate in order to test their relationship and interplay. The primary goal of the OCSI was to develop a theoretically driven and supported instrument, departing from an organizational climate model and allowing the identification of various dimensions to characterize safety climate. However, as suggested by Silva, et al., there was a need to determine if the OCSI questionnaire still predicts accidents in a bigger sample and to verify if the OSCI also has some discriminant about convergent validity and stability over time. Although their work came under the umbrella of safety management, the purpose of their study and findings are different from what I was trying to find. Thus, for similar reasons given in the previous paragraph, the work of Silva, et al. was not included in the final list for further analysis.
**Cut-off point and data saturation**

More examples similar to the work of Cox, et al. and Silva, et al. can be cited in order to explain why they were not included as a potential candidate for detailed evaluation. If the work is to be exhaustive, it can become another nightmare. The problem was that, in conducting a survey of this kind, there was no identifiable boundary. However, there should be a cut-off point as well as a state of *data saturation*. O’Leary (2004) suggests that:

“To finish collecting data only when additional data no longer adds richness to understanding or aids in building theories.”  (ibid: 114)

As discussed above, the work and findings of Cox, et al. and Silva, et al. did not match the specified criteria. They are relevant for safety management studies but irrelevant to our understanding of the subject being studied. While, statistically, the goal of this meta-analysis using 32 pieces of work was unlikely to be representation of the complete collection of literature, an in-depth examination of 280 pieces of peer-reviewed publications has given illumination to the body of knowledge about critical capabilities and safety success factors. A set of saturated data is good enough. There is no point, for example, to add the work of Cox, et al., Silva, et al. and other irrelevant ones to the list in order to make the figure statistically more significant and representative. By including every piece of work on safety management in the analysis, it would help boost up the sampling size and make the figure much more appealing and statistically more representative. However, I’m afraid this would not alter the final results to any significant degree. The quality of the results depends on the richness and relevance of the contents, and how well the selection criteria are met.
**Table 4-1: Selected literature for meta-analysis**

<table>
<thead>
<tr>
<th>Source</th>
<th>Author/Articles Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Øien, K. (2001)</td>
</tr>
<tr>
<td></td>
<td>Elms, D.G. (2001)</td>
</tr>
<tr>
<td></td>
<td>Santos-Reyes, J. and Beard, A. N. (2002)</td>
</tr>
<tr>
<td></td>
<td>Mitchison, N. and Papadakis, G. (1999)</td>
</tr>
<tr>
<td></td>
<td>Dahlgren, K., Lederman, L., Palomo, J. and Szikszai (2001)</td>
</tr>
<tr>
<td></td>
<td>NOHSC (1999)</td>
</tr>
<tr>
<td></td>
<td>Richardson Consulting (2003) Rail Safety &amp; Standards Board. UK.</td>
</tr>
<tr>
<td></td>
<td>Gadd, S. (2002), Health &amp; Safety Laboratory, UK</td>
</tr>
</tbody>
</table>

**Factors contributing to safety management success**

A detailed analysis of the contents in terms of safety determinants or critical success factors is tabled in Appendix 2. All together 106 factors contributing to safety management success were identified and they were grouped into 12 sets of key safety functions in order of priority (see Table 4-2).
### Table 4-2: Contributing factors cited in literature (listed in order of priority with No. 1 being the most important one)

<table>
<thead>
<tr>
<th>Contributor factors cited in literature</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Effective safety training and personnel development</td>
<td>23</td>
</tr>
<tr>
<td>2. Effective Communication &amp; feedback (e.g. self-reporting, integrated safety reporting, communicating recommended control procedures and programs to decision makers and workers, reporting of near miss occurrences, internal &amp; external communication, etc)</td>
<td>18</td>
</tr>
<tr>
<td>3. Risk management &amp; hazard control (e.g. statement of principles for hazard prevention and control, risk management strategies, developing methods for identifying hazards and evaluating loss potentials, risk assessment, identification, analysis, risk mitigation, risk control, ALARP concept, regulating risk acceptability, corrective and preventive actions, etc)</td>
<td>15</td>
</tr>
<tr>
<td>4. Safety policies &amp; goal setting (e.g. setting safety objectives, functional requirements, standards development, performance criteria)</td>
<td>13</td>
</tr>
<tr>
<td>5. Management commitment &amp; involvement (e.g. management support, senior management commitment, review of safety performance by management, safety as part of staff appraisal criterial)</td>
<td>12</td>
</tr>
<tr>
<td>6. Risk assessment and analysis (e.g. functional and structural, gap analysis, job analysis, consequence analysis, etc)</td>
<td>11</td>
</tr>
<tr>
<td>8. In-house regulations, rules, procedures and guidelines (realistic and flexible norms and rules, whether safety procedures for critical works have been identified)</td>
<td>11</td>
</tr>
<tr>
<td>9. A sound system of safety review / audit or evaluation strategies</td>
<td>10</td>
</tr>
<tr>
<td>10. Planning, coordination, organization, control</td>
<td>9</td>
</tr>
<tr>
<td>11. Clarification of roles, responsibilities and accountability</td>
<td>9</td>
</tr>
<tr>
<td>12. Regulatory management - compliance with standards and regulations. Checking of non-compliance &amp; adherence to site rules (e.g. low tolerance of rule violations, control on non-conformance)</td>
<td>9</td>
</tr>
</tbody>
</table>

The 106 factors listed in Appendix 2 reflect the findings as well as the intention of the authors to investigate different functions of safety management systems or strategies. Studying the selected cases according to the specified criteria offers the potential for a greater relevance of safety functions and factors to be identified, and therefore a greater likelihood of distinguishing relevant critical safety functions and uncovering the factors influencing safety performance. It also allows for a broad spread of cases and balance across different industry sectors. The intention here is not to study the safety determinant factors in specific industries. Rather, on the assumption that the principles and content of safety management systems and their functions are autonomous, the intention is the development of a list of priorities that is relevant and applicable across industry. As indicated in the previous section, the selection of publications (or cases) was based on a three selection criteria for scoping purpose. We might also be interested in the probability that how the result might be affected if a few more cases is added, or if there is any real benefit in adding more samples. As argued in the previous section, to include more safety management publications outside the scope of study do not really add much value to the findings if the data become saturated or near to ‘saturation. I would therefore reiterate that it is the
relevance and quality of data that help delve into the complexity of analysis and provide credibility for the findings.

The findings suggest that the top three most important factors were “safety training and personnel development” ($n = 23$), “communication and feedback” ($n = 18$), and “risk management & hazard control” ($n = 13$). It should, however, be noted that not all the factors were independent. For example, “risk assessment and analysis” and “risk management and analysis” were not mutually exclusive. And risk management and communication are clearly the important ones. It is generally known that one reason for poor performance predictability is that organizations themselves do not support open communication and risk management early enough.

Based on the accumulative evidence summarized above (Table 4-2), it is clear that “effective safety training and personnel development” is on top of the priority list. The result provides evidence to support the idea that capability development is an important strategy that helps us shape our safety destiny (for a full discussion of the strategic capability approach, refer to Chapter 6).

**Critical Capability Inventory**

As stated in the concluding paragraph of Section 4.3, “Critical capabilities” are primary abilities that merit a strategic focus of development to be identified. These critical capabilities identified in this meta-analysis are summarized as a set of “Critical Capability Inventory” (Table 4-3). And the main category and subsets of items are outlined here for ease of reference:

**STRATEGIC**
- Goal-setting capability
- Risk management capability
- Safety training capability

**OPERATIONAL**
- Risk communication capability
- Operational and administrative capability
# Critical Capability Inventory

The following is a list of critical capability sets stemmed from the meta-analysis that I conducted in 2004 (see Chapter 4, Section 9). The critical capability sets (Set 2 to Set 4) are determined by the TOP THREE strategic areas as identified in the meta-analysis.

## Strategic

### SET 1: Goal-setting Capability

1. formulate and review safety policy in accordance with what is required by law
2. determine safety needs and make changes to safety goals if necessary
3. secure senior management commitment and policy support
4. integrate risk management into strategic decision making
5. review and evaluate safety performance

### SET 2: Risk Management Capability

6. define a risk management framework and implement a process for carrying out risk assessment
7. identify hazards in the workplace
8. evaluate risks in response to hazards identified
9. set acceptable levels of risk
10. identify suitable responses to risk and implement appropriate control measures
11. review assessment of hazard and effectiveness of control methods

### SET 3: Safety Training Capability

12. identify safety training needs of the organization
13. plan and implement the training of staff involved in risk assessments
14. provide in-house training in safety/risk management for management staff
15. mainstream safety at work for employees by providing appropriate competence training
16. review training strategy on a regular basis.

## Operational

### SET 4: Risk Communication Capability

17. establish a communication process for risk communication
18. communicate information about work-related hazards to all relevant parties
19. promulgate instructions and guidance relating to legislative requirements
20. organize and promulgate safety information using appropriate information systems
21. prepare safety manuals and propose in-house safety rules

### SET 5: Operation and Administration Capability

22. facilitate safety committee meetings
23. develop and implement safety plans
24. check compliance with legislative requirements
25. conduct routine safety inspection
26. conduct induction training for new employee
27. conduct accident investigation and incident analysis
28. reinforce in-house safety rules
29. prepare accident and incident reports
30. compile and analysis safety statistics
31. resolve safety problems reported by subordinates
32. establish emergency procedures for potential accidents or disastrous happenings

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**Table 4-3:** Critical Capability Inventory
**Importance of capability development and implications**

The qualitative analysis confirmed that 23 out of 32 cases (i.e., 72% of the publications) reiterated safety training and personnel development as one of the safety success factors. The factors that appeared to facilitate effectiveness in capability building among the sample cases included: providing leadership for learning, creating conditions that were supportive of organizational learning and raised awareness of the importance of safety, identifying training needs of the organization, planning and implementing risk related training, reviewing training strategy on a regular basis, and implementing evaluation and monitoring systems. The major weakness among the sample of cases was that none of them had managed to mainstream safety at work for employees by providing appropriate competence training so as to sustain the implementation of a supportive cultural environment for learning about safety. As a result, other safety efforts, for example in goal-setting, risk management and risk communication did not achieve consistency, cohesiveness.

The results are important and several implications emerge from the review and analysis so far. First, the findings demonstrate the role and priority of capability development, and strategic management insights into the study of capability requirements. Secondly, the findings and analysis yields new knowledge by identifying specific capabilities that were found to be critically important for setting our development goals that may be important for organizations in developing safety management systems in similar contexts of uncertainty and rapid change. Thirdly, investment in learning and capability development should be goal-driven and the strategy should be grounded on what is critically required. At the core of this meta-analysis study is the idea of a possible value train in which management development with appropriate priorities and proper focus creates or adds strength to safety management capability. The key parameters are now in hand. Putting these together, they will become a coherent set of capability inventory ready for empirical applications (see Chapter 7 – Assessing safety management efficacy).

**4.10 Chapter summary and discussion**

To understand the meaning of ‘critical capability’, it is necessary to clarify what ‘criticality’ means. In this chapter, I argue that “criticality” is a form of a cultural chain reaction. To be critical, means having the strength of being sufficiently broad enough to serve as a source of critical reflection on a large number of central issues in management studies. In terms of capability development, I refer ‘criticality’ to a critical mass of coherent capabilities essential for creating a chain of action and reaction that creates a future capability niche.
In my view of “critical mass”, capability development includes two different components: 

**strategic learning** as a process and **critical capability** as the product. Using the “Dam” metaphor, it can be seen that, while **strategic learning** (i.e. increasing the height and strength of the Dam) helps individuals **build potential** for performing and achieving, **critical capability** increases the capacity of an organization to meet its strategic goals and objectives. It is therefore clear that these components of learning and capability building are mutually dependent. With the same rationale, it is my assertion that amongst critical capabilities some form of dependency also exits. This *proposition of mutual dependency* is the underlying assumption on which the hypotheses will be based (Chapter 6, Section 8).

The approach of capability development is the focus of my study throughout this thesis, especially in identifying critical capabilities, framing the approach and evaluating the ways in which capabilities are relating to each other. The capability development approach should be viewed as a continuous process: a process of strategic learning, involving the setting of priorities and choosing particular solutions strategically over time. The resulting choice and the rules so established can be regarded as generalizations of safety-maximization through strategic choice. These meanings and explanations are justifiable claims. The process of choice shows how the concept can be used to operationalize the capability approach and illustrates their differential impacts on the state of well-being.

Critical capabilities were identified as the key variables of the Safety Management Efficacy Scale (the design of which are detailed in Chapter 8, Section 8.3). The approach involved analysis of carefully selected safety literature, which includes:

1. collecting evidence, based on findings of previous research by other researchers in the last 30 years,

2. evaluating significance and relevance of the indicator variables (Appendices 2 and 3) using a summative approach, and, with these literature findings,

3. producing a five-dimension and two-tier domain map (see Table 4-3).

The identified safety management capabilities are presented in **Table 4-3** as a set of **Critical Capability Inventory**. The inventory is based on the original work, stemming from my literature review in form of meta-analysis. The inventory classifies these tasks as a series of activities which are linked from the operational to the strategic level of safety management.

For future enhancement of the Safety Management Efficacy Scale (SMES), I would advocate one of two options. First, based on generally accepted good practices, expert opinions or experience, the developer could potentially modify individual subscales with validated assessment items for each of the evaluation dimensions (i.e. respectively, the criterial tasks and
the critical capability sets). Secondly, in light of changes over time, I propose continuing the development process, using the meta-analysis approach. The process of extracting relevant data from literature continues in an interactive manner until a point where data saturation or redundancy is reached (O’Leary, 2004). As discussed in the previous section, data saturation occurs when further investigation and data extraction bring no significant additional rigor to the generative mechanism (i.e. the meta-analysis approach) and when evidence is strong enough to support practical adequacy of the findings. That is, one continues to sample until little new information is gained from the generative mechanism. By ongoing reviewing the relevant literature and research findings of other researchers, the developer of the instrument could keep on revising the key variables, in the end enhancing the assessment criteria to improve the overall validity of the instrument. With further studies in this direction, the evaluation framework, the Critical Capability Inventory and the SMES could eventually become more robust.

Clearly, in the end, building and developing critical capabilities is seen as my central claim that helps leverage our human potentials. It should play a central role both in capability development at the individual and at the organizational level. For the present purpose, it is important to note that aspects of strategic choice and identification of critical capabilities has been the subject of considerable discussion in the literature reviewed in this chapter. The ways in which the issues discussed in literature will be formulated and mapped out in an optimization framework of capability development. This will be the primary aim of the work reported in the coming chapters.
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Chapter 5: Theoretical foundation and supporting theories

5.1 Introduction – “ways of relating”

This chapter provides a theoretical background and the rationale of my approach to capability building and development (hereafter called “the approach”). As just discussed in Chapter 4, critical capabilities relate to one another in ways that might have an overall coherence, at least insofar they share the same purpose with a particular strategic focus. In studying these relations, I don’t mean the narrow logic of my argument, which supports or rejects by the arguments advanced in the previous chapters. I mean instead some basic considerations and background theories relating to the conceptual model of the approach that I’m going to develop. Because those considerations are brought together in the phrase “ways of relating”, I’ll start with discussing its connotations, and clarify some of the meanings and their implications.

In capability development, “ways of relating” addresses the fundamental nature of how human beings or things relate to each other, and how this affects the discourse and practice of human functionings and systems change. To explain what is possible, a dialectic framework is proposed. The purpose of which is to set the context and illustrate the relationship between the essential ingredients of the approach. The issue is dynamic and complex. I admit to being a partial critic. But, I believe that the proposed framework and selected theories allow us to avoid a return to the usual thinking of “legal compliance” or “one size fits all”. Instead, we can move towards accounts that examine the way capability shapes our safety destiny for achieving a desirable state of our well-being and a proper functioning of our workplace.

So, besides what we learn from the literature, are there other ways of conceptualizing relations concerned with human capability development? If so, how do they manifest in practice?

35 The process especially associated with Hegel of arriving at the truth by stating a thesis, developing a contradictory antithesis, and combining and resolving them into a coherent synthesis.
A proposed dialectic framework

“So many people today -- and even professional scientists -- seem to me like somebody who has seen thousands of trees but has never seen a forest. A knowledge of the historic and philosophical background gives that kind of independence from prejudices of his generation from which most scientists are suffering.” (Einstein to Thornton, 7 December 1944, EA 61-574)

In order to see the forest, we may have to organize the surface confusion of the real world into a global perspective. In doing so we can see that a number of typologies \(^{(36)}\) have been suggested by other researchers to classify various ways of relating things, for example, ways of relating science and religion (Barbour, 1998). Similarly, in the context of capability building and development, a set of typologies might be useful for engendering a coherent set of landmark concepts or theories that facilitate our understanding of how things related to one another.

Here capability building and development represents a scenario or problem space illustrating how people and their capabilities relate to one another in a coherent way. The phrase “ways of relating” is intended to be used here to convey an image of coherence among different relations. As a coherent whole, we all have a certain kind of relationship, mutual dependence or interdependence with every other human being, whatever character that relationship might take. In the *I-Ching* (易經), the *Tai Chi* (太極) is the all-encompassing totality and, simultaneously, all of its component parts. The *Tai Chi* is formed by *Yin and Yang* (陰陽), much like the model of female (陰) and male (陽), or an atom that consists of the electron (Yin) and the proton (Yang). Based on this *Yin-Yang principle*, the *Theory of Complementarity* \(^{(37)}\) was created (Bohr, 1948). The theory states that opposites are complementary to each other, reflecting the mutual dependence theory of *Yin and Yang* formulated in the *I-Ching*.

Intuitively, based on Yin-Yang and Bohr’s Theory of Complementarity, a framework illustrating some dialectic views is proposed with the following key dimensions in mind: (1) Goal Dimension, (2) Action Dimension, (3) Theory Dimension, and (4) Practice Dimension. The ways of relating these dimensions are illustrated in Fig. 5-1 to set the context of exploration. Each of them is the corresponding part of its opposite closely relating to each other, for example, capability development versus human functioning, theory versus practice, strategic planning versus implementation. But they are in fact mutually supportive and integrative with each other. At the heart of the framework is human being with unique strengths and weaknesses. Overcoming one’s weaknesses through ongoing reflection is an essential part of the human

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\(^{(36)}\) Typology: the branch of metaphysics that deals with the nature of being.

\(^{(37)}\) Complementarity is a concept made popular by N. Bohr in his attempts to highlight crucial features of quantum theory.
learning experience. This ability of critical reflection is crucial for anyone who wants to expand his/her horizons in the FOUR DIRECTIONS with balanced and appropriate responses.

My schema above presumes that any debate or deliberation over a subject matter has at least two main dimensions or poles, which are defined, for example, by questions of pros and cons, benefits and harms, upside and downside, cause and effects, etc. Along each dimension, relevant views can be arrayed from one extreme to the other. These *Yin and Yang* typologies—goal and action, theory and practice, strengths and weaknesses—are possibilities within which particular views can be located. Or, these poles simply embody possible ways of dealing with or influencing each other. Our support of, opposition to, or creation of such institutions represents how we choose to relate to others. Theory and practice, planning and action, strengths and weaknesses, routines and strategies— all these simply describe *ways of relating* to people, or *ways of relating* to theory in practice. By examining their relationship, new perspectives might then open up. At least, we no longer deal with things in isolation.
Theoretical supports

The claims for capability development approach are supported by synthesizing a number of important theories, including:

- the “action theory” of Argyris & Schon (1974);
- the “contingency theory” of Van de Ven & Drazin (1985);
- the “resource-based theory” (Amit & Schoemaker, 1993; Barney, 1986, 1991; Dierickx & Cool, 1989; Mahoney & Pandian, 1992; Rumelt, 1984; Wernerfelt, 1984);
- the “capabilities approach” and “resource-based perspective” of Martha Nussbaum (2000); and in particular

These contemporary theorists teach us how to think or philosophize in the postmodern condition, in an age when the meta-narratives have lost their legitimating power. They provide a positive philosophical or theoretical response to the fragmentation and dissolution of our professional life. For instance, Donald Schön, Chris Argyris and Peter Senge adopt many different literary forms, sometimes within the same work. Their investigation is at once dialogical, confessional and, most of the time, their work involves understanding of human beings and how one thing leads to another.

The framework, from a system perspective, represents a simplistic view linking us to the outside world. By examining our own weaknesses and strengths, we can better prepare ourselves in developing our capability for enhancing our human functioning, for survival, for dealing with problems in hand, and for a better future in the light of changes. In our daily life (and work) we implicitly or explicitly put theories into practice, and we make plans and take appropriate actions in response to our personal or other worthwhile goals. This dialectic view was ridiculed by William James who said: “everything is self-created through its opposite – you go around like a squirrel in a cage” (James, 1884: 283) in contrast to dialectic which takes a stance in improvement through synthesis.

Similarly, the idea of self-creation is also well-founded upon an ancient Chinese philosophy, the “Yin & Yang”. Weaknesses and strengths, capability and functioning, theory and practices, action and goal, risk and safety, etc. are inseparable pairs. Each one of them is self-creating through its opposite. Each one of them represents either side of a coin, appearing to be opposite to each other but together they are parts of the whole.

38 An approach to quality of life assessment pioneered within economics by Amartya Sen, and by now highly influential through the Human Development Reports of the United Nations Development Program (UNDP).
The framework represents the essential ingredients of human capability development in response to an environment that drives social evolution with a self-perpetuating perspective. The process of development involves self-organization resting on the ability of nonlinear dynamic systems to create and sustain states of matter. The process displays regulatory and other remarkable properties, which would be exceedingly unlikely under equilibrium conditions (Nicolis, 1989: 336). The concept of self-organization has considerable relevance to people seeking to understand an individual’s capability. With self-perpetuating development efforts, “[we] can therefore say that non-equilibrium reveals the potentialities hidden in the nonlinearities, which remain ‘dormant’ or near equilibrium” (Nicolis, 1989: 332). What Nicolis describes is similar to the equilibrium state implicated by the philosophy of Yin and Yang.

In a self-perpetuating way, Ying and Yang will try to reach a state of equilibrium. The change within which is interdependent but nonlinear. Yin will not exist if there is no Yang, and vice versa. Safety would not be a concern if risk was not out there. But this state would be very unlikely because of the unarguable fact that risk is always the enemy of safety. To leverage potentialities for maximizing safety performance, we must therefore think seriously about the fundamental issue of improving our well-being as a kind of natural response that provides appropriate sensitivity, awareness, learning and action for restoring or maintaining the equilibrium state of our workplace environment.

In construing the framework established by contemporary professional development theories, I have taken a multiple-perspective that triangulates the emergence of an adaptive capability development system. It is an attempt to specify the relationships for understanding the mutual dependence between the three sets of variables with coherent reciprocity – (1) theory & practice, (2) goal & action, and (3) capability development & human functioning.

**Principle of coherent reciprocity**

The proposed framework suggests that our human activities usually operate in a rather more flexible way than would be demanded by any coherent reciprocity principle. According to James Grier Miller (1978), a fundamental concept in general systems theory is “the notion of emergence and interaction”; and a system, with coherent reciprocity, is defined as a set of interacting units with relationships among them. The properties of a coherent system as a whole emerge out of the interaction of the components and their individual properties. Because of the coherent reciprocity principle, management systems have constraints or boundary conditions and it evolves over time in response to its changing environment (Miller, 1978). In capability development, a typical example of reciprocity is the combination of motivation, appropriate learning environments, and
Reciprocity and coherence, as characteristics of the complex systems, provide the necessary conditions for the important mechanism of interaction and manifestation. This interaction and mutual dependence properties between associated parts and their physical environment, results in the formation of systems (Miller, 1978). Therefore systems are wholes with interdependent parts. Safety management, for example, is the systematic development and application of a combined set of technical, social, managerial functions and critical capabilities, aiming to reduce the probability and/or consequences of potential hazards in a specific working environment. The force generated by the variables (or the interdependent parts), either individually or collectively, accounts for the stability or instability of achievement and performance, and ultimately the achievement of system equilibrium. Thus, reciprocity should be a guiding principle for studying capability relationships. It should be demonstrated in practical ways, for example, relationship between critical capabilities, goal-setting and action taken to achieve a desirable state of well-being.

If we remove the heart, an organism dies. If we take away the critical parts (e.g. critical capabilities), or if the parts fail to interact or communicate with each other, the system ceases to function as intended. The communication, feedback and response between associated parts are instrumental for the corresponding parts to interact with each other and to function as an integrated whole. As a system, capability building and development is a tangible example of reciprocity in action. To study the whole system of development, we have to identify the critical mechanisms and how they interact with and relate to each other. This coherent property of reciprocity, by ways of relating, interacting, integrating, communication and responding, is what I call it “coherent reciprocity”.

**Goal-setting versus action**

The framework relates actions to human goals. But, why should we have goals? What’s the purpose? The question is a simple but important starting point of almost everything we do. However, we have learnt from the literature (see Chapter 3) that during the various major philosophical management shifts safety has gone its own way, ignoring our basic safety goals and reality. Most safety programs remain “classical” in nature – management decides and people follow the rules without really understanding the purpose. Most people simply follow rules, procedures and regulatory requirements.

In the previous chapter, I argued that ‘criticality’ is a form of a cultural chain reaction when collective thinking and behaviours reach a critical mass. When we live or work with
certain safety or risk perception within certain parameters, by certain rules or principles, we act in certain ways in relation to one another. When we live within a certain tradition or culture we think, act and learn quite differently because of certain influence by culture difference or similarity. Such kind of relationship is cultural in context but very often goal-driven or goal-directed.

Our management thinking, goals and approaches keep changing with the changing world. When we have gone through a paradigm shift, everything we have believed in the past becomes suspect. So, we first must realize that a paradigm shift has taken place (for example, a change in safety legislation) and we must understand the purpose. We have gone through classical management in the 1950s to human relations management in the 1960s to situational management in the 1970s to cultural management in the 1980s to downsizing, TQM, and reengineering in the 1990s. These are the major shifts in management philosophy. In all these contemporary paradigm shifts, apparently, there are some common goals related to the fulfillment of human satisfaction. All these moves are goal-directed.

In cognitive science, psychology and education, a growing body of research supports the view that organizational and human behaviors are largely goal-directed. As far as safety management is concerned, the central idea underlying a goal-driven strategy is similar to other business and organizational functions. The goals are linked to the value of safety. The choices depend on how well safety efforts contribute to achieving business continuity. The safety management process should therefore be guided by reasoning about the information that is relevant to serving those goals.

Goal-setting is geared to achieving a better result with minimal effort. Psychological evidence supports goal-based influences on human activities (Barsalou, 1991; Faries & Reiser, 1988; and Zukier, 1986). The concept of goal-based influences is very much related to the “goal satisfaction principle” of Hayes-Roth and Lesser (1976), which states that “more processing should be given to knowledge sources whose responses are most likely to satisfy processing goals”. Psychologically, the most satisfying goal could be nothing other than the one that provides the greatest possible satisfaction. However, knowledge and experience are some of the decisive factors that influence our goal-setting and decision making process. The relevance of our knowledge and information affects our choices and makes manifest our intention. The “relevance principle” of Sperber and Wilson (1986) implicates that people pay attention only to information that seems relevant to them. Those principles, relating to goal satisfaction and relevance, make sense to us in strategic planning for capability building and development because cognitive processes of goal-setting are geared to achieving a large effect for a small
effort. To justify our choices in goal-setting, we must focus our attention on what seems to be the most relevant information that we can access.

The process of capability development involves goal-setting, strategic learning and taking actions. The effectiveness of goal-driven safety management depends on being able to make good decisions about what, when, where and how to act, on selected appropriate strategies for achieving the desired outcomes. However, there is a danger that we might look for quick fixes if we loose sight of the strategic nature of our goals, in particular when the required capability is not readily available. It should be clear to us that well defined and relevant goals in the process of development can facilitate learning and capability building.

**Theory and practice – how do they link?**

The concepts and strategies are abstracted out of their theoretical framework. Putting theories into practice requires a clear understanding of the links between the key concepts and strategies suggested by the relevant theories. Learning concepts and strategies should therefore be grouped together. The groupings should be based on their relevance to a particular goal or performance objective, for example, in the development of a specific capability or skill set. In this view, learning is a constructive process in which the learner is building an internal representation of knowledge and experience (Bednar, Cunningham, Duffy, Perry, 1995). In the process of capability development, this knowledge representation is constantly open to change. In a subtle but coherent way, the structure and linkages between knowledge and capability sets become the foundation to which other knowledge structures are linked.

Capability development involves putting theories into practice. Learning theories and putting them into practice is an active learning process. Conceptual growth, as a learning process, comes from our assumptions and the sharing of multiple perspectives. This process is developed on the basis of experience and accumulation of knowledge. This view of learning does not necessarily deny the existence and influences imposed by the real world. In fact, it agrees that reality places constraints on acquisition of knowledge and experience. The contention is that all we know of the outside world are interpretations of our experience of the world (Kolb & Fry, 1975). Some perspectives are unique and some are shared. This process of conceptual growth involves simultaneous changing of our thinking in response to those perspectives as well as through cumulative experience. The assumptions associated with ‘theory and practice’ in turn yield a set of paradigms that define the way we conceptualize the world and how we choose to learn from it.
5.2 Relating contingency perspective and action theory to capability development

Learning and capability development, as just discussed, are complex and situational involving some basic assumptions about ‘reality’. Ontologically, it is assumed that the reality of how things work is the product of our actions and consciousnesses. This means that our interpretation of what is happening will depend on the reality of our situation and the influences imposed by our surrounding environment, including people we are working with. Epistemologically, while some practices can be learned from others it is assumed that useful and relevant knowledge is generated at a personal level by experiencing, by reflection or by applying knowledge and skills in an immediate and relevant setting. However, it is not surprising to find that for many forms of education, learning and capability development, the dissonance between desired learning and demonstrated learning is encapsulated by a physical metaphor; that of a gap (Gallagher, 2004).

But how big is the gap? No one seems to have an immediate answer. But, in the simplest form, the metaphor of a gap means that the two components, theory and practice, have a separate location separated by a gap. Implicit in this metaphor is the belief that it is highly desirable for the components to be drawn closer together. Thus, in the selection of a theory or practice, my basic assumption is that it would need to provide ways of modifying the world, closing the capability gap, or something useful for people to take action in. My choice of theories below reflects the necessity to accommodate these features and, as far as possible, to close the capability gap.

Contingency view

My experience, through teaching and consulting, has shown that there is an insufficient understanding about the priorities in dealing with safety management issues. There is therefore a variation in how well practitioners get on with doing what must be done. While literature concerning safety management efficacy and capability is rather limited, a more useful understanding of the situation could be found in contingency theory (Van de Ven & Drazin, 1985) which has been developed in the discipline of management or organizational studies.

Contingency theory needs to be briefly touched upon to emphasize that there is no one best way to organize an enterprise of its operations. Therefore, any methodology for determining critical processes and any evaluation model developed for configuring safety management processes needs to be in a dynamic format which can be uniquely employed by the organization with varying results and degree of capability maturity. The contingency view questions the use of
universal management practices and placing emphasis on the use of traditional and systems viewpoints independently or in combination to deal with various situations.

The contingency view of management or situational approach emerged in the mid-1960s. The contingency approach assumes that managerial behavior is dependent on a wide variety of elements, and that appropriate management approach depends on situational factors faced by an organization. This view emphasizes the fit between organization processes and the characteristics of the situation, and it calls for fitting the structure of the organization to various possible circumstances.

No size fits all! Organization theory-based research attributes the popularity of contingency theory partly to a fundamental assumption that there is no one best way to organize, and that any one way of organizing is unlikely to be best way and not equally effective under all conditions (Galbraith, 1973). To respond to environments of uncertainty and change, various differential structures were adopted by successful organizations versus unsuccessful ones (Lawrence & Lorsch, 1967). Lawrence and Lorsch argue that if the open system perspective is taken, rational and natural perspectives identify different organizational types which vary because they have adapted to different types of environments. Unlike Etzioni’s (1961) structural view which sees the two perspectives as two sides of the same coin, Lawrence and Lorsch see them as different organizations entirely.

Contingency theory suggests an interdependence of management strategy, organizational structure, and competitive environment in order to achieve high performance. The best way to organize, therefore, depends on the nature of the environment to which the organization must relate. The problem in creating responsive management processes is that there will be no one overall solution. A study conducted by Priem (1994) supports that judgment policies favors strategy and structure, but environment matches produce higher performance than do other judgment policies. To make the story short, the contingency approach is based on the concept - “it depends.”

In summary contingency theory is a theoretical backdrop for developing effective, responsive management processes. Contingency theory asserts that when we make a decision, we must take into account all aspects of the current situation and act on those aspects that are important for the situation at hand. In order to provide long-term solutions and make sustainability possible, it can be argued that we rely on our capability as well as our sensitivity and adaptability in response to the changing nature of the environment.
Argyris and Schön's theory of action

The notion of a theory of action can be traced back to the early work of Chris Argyris about the relationships between individuals and organizations (Argyris 1957, 1962). Since the early 80’s, Chris Argyris and Donald Schön’s work has been concerned with examining conscious and unconscious reasoning processes (Dick & Dalmau, 1990). Argyris also examined some of the problems encountered by managers in their work. In particular, he is concerned with “built-in inefficiencies” in the decision-making (what people say) that can affect the operation of the entire organization (what people do). Argyris and Schon suggest that there is a theory consistent with what people say and a theory consistent with what they do. Therefore the distinction is not between “theory and action but between two different "theories of action" – i.e. the concepts “Espoused theory” and “Theory-in-use” (Argyris, et al., 1985: 82):

Espoused theory - The world view and values people believe their behaviour is based on

Theory-in-use - The world view and values implied by their behaviour, or the maps they use to take action.

To reiterate these theories are suggesting that people are unaware that their theories-in-use are often not the same as their espoused theories, and that people are often unaware of their theories-in-use. However, Argyris & Schon’s “theory-in-use” (1974) asserts that we hold mental maps about how to plan, implement and review our actions. In this Argyris & Schon suggest that all people, not only professional practitioners, need to become competent in taking action and at the same time reflecting on this action in order to learn from it.

The term action is equivalent to performance. “It implies only the ability to see a connection between the actions and effects over a range of circumstances.” (Coleman, 1976: 52). For example, actions of people are governed by their worldview and personal values implied by their behavior (Argyris & Schon, 1974). Above and beyond individual actions, the implication is also that organizations need to emphasize on the development of performance related capabilities. The development strategy needs to be linked with other organizational functions and with existing systems. In this one may notice, action theory is one of those unique areas in epistemology with a boundary that is difficult to ascribe. Some refer it to organizational learning (e.g. Senge, 1990), and some regard it as change management. However, at the basic level, the action theory of Argyris and Schön (1978) suggests that there is a theory consistent with what people say and a theory consistent with what they do. The distinction is not between theory and action but between two different "theories of action" (Argyris, Putnam & Smith, 1985: 82). In their original work, Argyris and Schön (1974) describe organizational learning as comprising single-loop and double-loop modes of learning and change (Fig. 5-2). The implications are
associated with identification of constraints and self-sealing processes, as well as how to become a more reflective practitioner, because “… in a self-sealing world, professionals may find it difficult or impossible to recognize the limits to their ability to predict new professional role demands.” (ibid: 153).

![Fig.5-2: Single-loop and Double-loop Learning (Argyris & Schön, 1978: 2)](image)

In the end, can Argyris and Schön’ action theory inform the designers and implementers of safety management systems to help increase the likelihood of their success? As pointed out earlier, safety suffers from the variety of problems associated with methods and models that are used to assess human performance. Nevertheless, risk cognition and safety provides an integrated view of cognitive and social issues to better enhance safety. Safety management, similar to other business and management functions, can be regarded as a human cognitive system (e.g. human capability, beliefs, concepts, intentions, plans, and actions) which is sensitive and adaptive to its environment. The system makes a representation of the problems, acts on the basis of the representation and learns from the results of people’s actions. The system is concerned with thought processes and the phenomenology of human consciousness (as explained in Chapter 2 about risk perception). Because of these human cognitive elements and processes, I would regard human capability development as a human cognitive system. In order to understand how safety practitioners manage safety at work, especially on strategic issues, the Social Learning Theory of Bandura (1986) is therefore used to examine what they believe and what they are confident in doing with an “belief-action” perspective. As can be seen (in the following chapters), the use of Bandura’s theory is quite consistent with Argyris and Schön’s social cognitive perspective as expressed in their Action Theory.

To sum up, the models (e.g. double-loop learning) and action theory developed by Argyris and Schön are for the purpose of helping people to be able to make more informed choices about their actions and capability development. To this end, they have developed models which seek to explain the cognitive processes and governing parameters of organizational learning. Similarly, the Strategic Capability Development approach that I’m trying to develop (see Chapter 6) is intended to serve a common purpose although with a different contingent approach.
5.3 Relating resource-based view to capability approach

To make the best use of available resources – tangible and intangible, organizations require the right capabilities. Such capabilities come in many different forms, e.g. strategic, operational and managerial. They may, for example in the case of safety management, be the command of a particular safety strategy, a set of high-level risk assessment skills, and set of effective risk control measures, an able safety inspection function, or an aptitude in introducing a new integrative quality and safety system. Moreover, on an intrinsic level, they are in themselves unique human resources, available to managers and other members, to be deployed in different ways. However, rather than focusing on the amount of resources individuals are able to command, Nussbaum (2000) is concerned with what "each and every" person is "actually able to do or to be" with the resources available to them. Similarly, for me from a practical point of view, the central question driving the capability approach is: “What are individuals actually able to do or to be?”

Resource-based theory

Resource implication is one of the major constraints which impede the implementation of Safety Management Systems. To establish a theoretical foundation for this work, one may find it useful to have an understanding of what is meant by “resource-based theory” or “resourcist approach”.

Why resource-based? Resource-based theory has a long tradition in organizational and social studies as well as in the area of social welfare. Very often the application of the theory is referred as a “resourcist approach”. A key problem of the resourcist approach, as pointed out by Martha Nussbaum (2005) is that: “giving resources to people does not always bring differently situated people up to the same level of capability to function.” Her point is that societies governed by resourcist conceptions and assessments, systematically disregard interpersonal differentials in needs and capacities.

The resource-based perspective argues that sustained success or competitive advantage is created by the unique resources at the core of an organization (Conner & Parhalad, 1996; Barney, 1991). This view, on which resource-based theory is grounded, describes how organizations build their business from their resources and capabilities (Dollinger, 1999). The theory addresses the important issue of how superior performance can be attained. Implicit in the resource-based theory is the centrality of using capabilities in explaining an organization’s performance.
Resource-based theory: a historical Overview

Over the last decade the resource-based view of the organization has been widely adopted by scholars in their explorations of sources of sustainable competitive advantages. This stream of research basically suggests that differential organization performance can be attributed to the resources that an organization possesses (Barney, 1986, 1991; Dierickx & Cool, 1989; Rumelt, 1984). Building upon such a generic conceptual basis, subsequent research efforts set forth the concept of core competencies (Prahalad & Hamel, 1990) and postulate a comprehensive framework for competence-based management (Hamel & Heene, 1994; Heene & Sanchez, 1997; Sanchez, Heene & Thomas, 1996).

The resource-based view of the organization has been evolving as a new organizational theory since the 1980s. Conner (1991) compares the resource-based theory to other theories in Industrial Organization economics. The strategic resources of an organization are said to be heterogeneous between enterprises and these resources may not be perfectly mobile across enterprises (Barney, 1991). Implicit in this theory is the need to understand how the resources of the enterprise or organization synergistically come together to create a sustained competitive advantage.

One central notion drawn from the capability-based framework, focusing upon the management of an evolutionary process containing both capability building and capability leveraging activities, is vital to an organization’s success (Sanchez et al., 1996:13). In brief, capability leveraging refers to the exploitation of an existing stock of competencies, while capability building indicates the exploration of qualitatively new assets or capabilities for the organization (Christensen & Foss, 1997: 290; Sanchez et al., 1996:22 & 24). To achieve dynamic corporate coherence (Christensen & Foss, 1997), a successful organization has to establish a business operation model containing both processes from a resource point of view (Collis & Montgomery, 1997).

In essence, an organization’s resources include all assets, capabilities, organizational processes, organization attributes, information, and knowledge controlled by an organization that enable the organization to conceive of and implement strategies that improve its efficiency and effectiveness (Daft, 1988). Furthermore, strategic management utilizes resource theory as the fundamental characteristic of performance and competitive advantage (Barney, 1986; Rumelt, 1984). The resource view of the organization is therefore concerned with the unique competitive advantages of individual enterprises (Rumelt, 1984; Teece, 1982; Wernerfelt, 1984).
Resource-based theory & safety optimization

Safety optimization is an ultimate goal. The contingency approach (proposed in Chapter 6) shows how organizations can both reconfigure their capability development strategy and create operational synergies through managing different types skills and experiences. Secondly, while capability leveraging suggests that improving access to resources beyond the traditional boundaries of individuals is crucial to the success of capability building (e.g., Araujo & Easton, 1996; Elfring & Baven, 1996; Jensen, 1996; Stein, 1997), such a managerial endeavor is far more challenging than other types of resource-based strategy. Despite the fact that a variety of capabilities is available within an organization, there exist some structural constraints on the inter-organizational learning processes relating to infrastructure support services, such as safety and risk management. These constraints are largely due to oversights in dealing with this kind of issues which are externally imposed.

In other words, my conceptualization of the contingency model (see Chapter 6) highlights the need for realignment of goals and strategies aiming at creating a self-reinforcing cycle containing both capability-building and capability-development activities. On one hand, the present work may advance our understanding of the dynamics of practitioners’ safety activities, while on the other hand, in the light of Penrose’s proposition of creating a virtuous cycle of resource building and leveraging, our results may draw implications for practitioners in their pursuit of sustainable growth (Penrose, 1959). By founding the approach on resource-based theory, the logic underlying the capability-based model I propose could serve as a useful framework for the development of responsive and effective safety management.

Founding ‘capability development’ on resource-based theory

Within the evolutionary approach, the resource-based theory has consolidated around the assumption that the creation of capability is a distinctive feature of the organization. In criticality, the resource-based theory can be thought of as a development and an application of the “economics of learning”. The characteristics of learning processes, such as learning by doing and learning by using, and their relevance in explaining organizational change has led to the identification of the organization as the primary locus of the generation and valorization of knowledge and capability immediately relevant for the specific action (Loasby, 1999). The emphasis here is put on the process of capability development by means of which the organization is able to introduce organizational innovations or management initiatives (Penrose, 1959). The resource-based theory is therefore viewed as the locus where capability is generated by means of the integration of learning processes and formal development activities. The
organization is considered in this approach primarily as a depository and a generator of competence (Foss, 1997).

The fundamental assumptions, at least as expressed in Foss (1997) is that differences in organizations’ resource endowments causes performance differences (see Foss, 1997: 4). For many organizations, the implementation of a resource-based strategy (e.g. the concept of core competencies set forth by Prahalad & Hamel, 1990) has brought about many advantages and performance improvements. Given that the resource-based theory addresses the capabilities of an organization as an underlying factor of performance (Conner & Parhalad, 1996; Collis & Montgomery, 1997; Sanchez et al., 1996; Dierickx & Cool, 1989; Barney, 1986, 1991; Rumelt, 1984;), it was found to be a suitable theory to use in this study. Founded on a resource-based perspective, my model adopts the ‘capability approach’ of Amartya Sen that I respect for its applications in humanity and capability development.

### 5.4 Capability development and human functioning

Our experience in learning builds over time into subjective patterns. It shapes what kind of people we recognize ourselves to be and what we believe ourselves able to do without questioning broader social issues about how society and oneself ought to be improved and changed (Nussbaum, 2000), and about the kind of knowledge, attitudes and skills that participation in an improved and more desirable form of well-being requires (Sen, 1993). A key concern is thus how we overcome our weaknesses, and how we come to produce better, more convincing knowledge, which makes a difference in practice under which their formal and informal learning takes place.

Metaphorically, the idea of converting human capabilities into human functionings is shown in Fig. 5-3 at the beginning of this chapter to illustrate their relation.

![Fig. 5-3: Capability Development & Human Functioning](image)

The issue of building and developing capability confronts the issue of human resource more directly. Research about capability suggests that there is a need to develop an understanding of how to develop capable people (Graves, 1993; Stephenson & Weil, 1993; Stephenson, 1994). There is an increasing need to develop this understanding by focusing on the structure and
function of strategic capability, and how to enable capability to express itself in organization context (Hase, 1998).

From a resource perspective, in order to facilitate the capability development of others, managers and supervisors need to undertake a leadership role and be capable people themselves. This is particularly important on difficult or controversial subjects like safety management. A most important characteristic of a learning organization is the ability of managers to empower others, to share information, and to develop capability edge. A recent study of Hase, Cairns and Malloch (1998) asserts these characteristics. However, these are not new concepts. They are endorsed by many contemporary management writers, such as Sashkin and Sashkin (2003), Senge (1990), Conger and Kanungo (1988).

In capability management, it is not surprising that organizations continue to ignore the evidence of the success of such approaches. This lack of change might be found in the way in which managers are trained. One might notice that, instead of addressing the importance of vision and strategic goals, there is a heavy emphasis in organizations on the technical aspects of management (e.g. by focusing on plan-do-check-act). In addressing management deficiency or professional development, quite often a “fast-food” approach is used. The overabundance of short training programs attests to the simplistic approaches we take (Hase, et al., 1998). The approaches are quick-fixed and something out of context, especially in addressing future needs. To resolve the issue, the notion of a strategic approach would develop the most needed capability not just the competency. A fruitful approach is to recognize that strategic development enables people to express their capability in a multi-dimensional context, such as that found recently in a major construction company (Davis & Hase, 1999) and in other Australian commercial and government organizations (Hase, et al., 1998). In sum, in order to stay on course, strategic thinking is always involved.

The conceptual roots of Amartya Sen’s capability approach

For policy descriptions and evaluative analysis of human development, Sen’s capability approach can provide the useful theoretical foundations. In the intellectual traditions of philosophy, Sen has written extensively about the conceptual roots of human capabilities, welfare economy, and economics, dating back to Aristotle. Of course, as an economist by profession, his writings have included the works of Adam Smith among others. Both the United Nations Development Programs (Haq, Mahhub ul, 2004) and Sen’s own work (e.g. Sen, 1989) provide traces of these philosophical and conceptual roots despite the fact that there is no consensus on how the capability approach might be put into effective operation (Robeyns, 2000). But, for the measurement of individual welfare levels, Sen’s work is less impressive (Robeyns, 2004).
Central to the evaluative aspect of human development is the measurement focusing on human outcomes rather than economic growth in assessing progress. In reality, continued poor growth performance in developing countries is still a major obstacle to human development in many aspects, according to Fukuda-Parr (2002). However, an important feature of Sen’s capability approach is that it has been strongly founded in philosophical reasoning.

Basically, capability development is *human entitlement* concerned with the achievement of appropriate human functions (Sen, 1993; Nussbaum, 2000). It is about education in the formal settings or informal education in the professional settings that shapes our capabilities to live. In her many well-respected writings on her “capabilities approach”, social justice and ethical issues, Martha Nussbaum makes her belief clear and well known to the public by stating that:

“The basic intuition from which the capability approach begins, in the political arena, is that human abilities exert a moral claim that they should be developed. Human beings are creatures such that, provided with the right educational and material support, they can become fully capable of these human functions.” – Martha Nussbaum, The Little Magazine (available online at URL: http://www.littlemag.com/2000/martha3.htm, July 2005)

With this key concern, how might Amartya Sen’s (1993) or Nussbaum’s (2000) “capability approach” for example take us forward in relation to understanding and working in developing our human capability? The attraction I can see in their approach is three-fold:

1. Their approach points to what “people are actually able to do and to be” (Nussbaum 2000: 5); as social learning is fundamentally about what we learn to be as much as about what knowledge we acquire. It is, above all, a domain of activity requires thinking and judgment not only about what has been done but a guide to future action.

2. Its emphasis on the flourishing of every person’s human capability for better functioning and well-being (Sen, 1993), and hence a challenge, for example, to management to change their mindset towards capability development instead of relying too much on financial statistics which in fact doesn’t seem very useful about individual experiences.

3. It suggests a view of capability development as more than just for economic development, and incorporates an implicit view of capability development and understanding solidarity. (Walker, 2003).

Of a wider concern, Nussbaum (2000) takes her approach further to produce an ethical framework for evaluating the state of well-being in development planning and public policy. The basic idea of her capability approach in this respect is to address “what people are actually able to do and to be”, informed by the idea of “… a life that is worthy of the dignity of the human
being” (Nussbaum, 2000: 5). The capability approach also involves “being able to form a conception of the good and to engage in critical reflection about the planning of one’s life” (ibid: 79). This is also something at the heart of my proposed framework concerning the approach for enhancement of human functioning in matter of safety.

**Sen’s capability approach – an overview**

The concept of ‘capability’ developed by Amartya Sen in a series of economic and philosophical works (39) plays a major role in this study. Sen’s notion of capabilities describes individual well-being in terms of a person’s ability to achieve a given set of functionings and a desired state of well-being. In this context, the ‘concept of functionings’ reflects “the various things a person may value doing or being.” (Sen, 1985:75)

Central to Sen’s capability approach is the idea of development freedom (Sen, 1999a) and conversion factors, such as social and political rights (40). These are people’s entitlement as well as the characteristics of individuals, their society and their environment that together determine their capability to achieve a desired range of functionings. Conceptually, it is important to emphasize that Sen’s capability approach contains two central theses about human development. They are the “evaluative aspect” and the “agency aspect” (Sen, 2002). The first is concerned with evaluating capability improvements as an explicit development objective. In this human achievements are used as the key indicators of development progress. This approach contrasts with the traditional paradigms that focus only on economic performance in fiscal terms. The second is concerned with what human beings can do to achieve such improvements. Rather than having something to do with correction and control, the emphasis is on “development as freedom” (Sen, 1999a).

However, Sen has not sought to develop any juridical theory that might give his concept some definite organizational shape. Instead he insists that his capability approach does not prescribe any particular set of outcomes for a particular situation or a given group of societies. In this argument, we can see that the high level of generality and theoretical abstraction of his capability approach lends itself to adaptations which may be far from Sen’s initial formulation. Thus the work of my study is perhaps best thought of in this way or, at least, as an attempt to expand the horizon of Sen’s capability approach for professional application.

39 See, in particular, A. Sen, Commodities and Capabilities (Deventer: North Holland, 1985), and Development as Freedom (Oxford: OUP, 1999).

Flexibility and freedom of action


This thesis takes Sen’s point that ‘flexibility’ is frequently associated with greater diversity and variability in the application of social protection, and thereby having a strong implication on ‘health and safety’ for the protection of workers. However, this view overlooks the degree to which capabilities of people depend on whether they have access to the means that they need to realize their safety goals. These include guarantees of a certain minimum standard of workplace safety and the resources needed to maintain the basic functioning of their working environment in the face of risks, such as those arising from technology change and uncertainty. Therefore real freedom of action for organizations, in the form of protection of people at work and people’s safety rights, has its equivalent in guarantees for the development of human resources for workers.

However, as my thesis suggests, these would not necessarily take the same form as the passive protections traditionally provided by organizations. Protection against risks, implied by Sen, is not the same as mechanisms aimed to maintain social security in the face of risks:

“The capacity to work flexibly is conditional upon being able to deal with consequences of risks. Protective regulations, because of the essentially negative way in which they are formulated, go against this kind of learning process. Security in the face of risk, on the other hand, is about providing the individual with the means to anticipate, at any given moment, long-term needs.” (Sen, 1985:278)

It is the basic idea that the purpose of capability development is to improve human lives by expanding the range of things that a person can be and do. This includes things such as to deal with risk effectively; be safe and healthy; to be knowledgeable and capable, and to have the freedom to participate. Here, entitlement, commitment and participation are the emphasis in capability development. Capabilities in the context of safety have to be conceived as: an individual entitlement; a commitment to provision of safety working environment; a commitment to change; and an openness toward and a willingness to deliberate and participate.

Human functioning

How do we decide which capabilities are of basic importance to humans? To answer this, we first need to see how Sen sees the term "capability." The fundamental insight of his approach is remarkably simple. It argues that the goal of both human development and functioning should be to expand the capability that people have to enjoy ‘valuable beings and doings’ (Sen, 1999a:75,
1992:39). They should have *access to the resources* they need in order to acquire these capabilities. And they should have the *freedom to make choices* that matter to them.

As we define (41) capabilities, it is important to distinguish that people who benefit from the exercise of their capability need not be the ones who have and use their capability. This has important implications on how we see things collectively and individually. In matters of safety, it is my claim that the capabilities are beneficial for human well-being at individual, organizational and community levels. Individuals should not rely on other persons to protect themselves for their well-being. People will themselves be benefited (and protected) if they develop at least a basic set of essential safety capabilities useful for dealing with safety at work in order to achieve the necessary safety functioning for the benefits of themselves, the organization and the others. This claim is based on the premises that a person’s capability reflects his/her potential well-being in contrast to the actual well-being which he/she has realized, and his/her achieved well-being is reflected in the achieved functionings (Sen 1985a).

A capability in the context of safety management is therefore a state that requires focused attention and deliberate effort to develop over time. When the required capabilities are developed, one may become more confident. The improved capacity enables one to function in ways that contribute to the well-being of oneself or others. The resulting functionings that allow an individual to contribute to his/her well-being may become either an improved service or enhanced state of workplace safety. In organizational context, the functionings that the capability enables may be carried out as part of a job for which one is paid.

Therefore, in the development of my theoretical framework, I hope to critically assess the issues of capability development and capability approach in light of both the afore-mentioned issues and framework of evaluative findings.

**Capability approach: the evaluative aspect**

In order to gain the attention of policy-makers in the process of making changes, reliable evaluation methods are much needed for justifying the claim of the approach as an alternative development paradigm. Therefore, establishment of valid measurement tools and indicators for evaluating human achievements is central to introducing the capability approach. Sen argues that these methods and indexes should evaluate the progress of development by advances in human well-being rather than only by advances in economic terms (Sen, 1998). But, in his argument, Sen seems to allow a bit of relativism as far as the evaluative aspect of his approach is concerned. His argument is perhaps based on the reality that capability is complex to measure in global

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41 See also Chapter 4 for more detailed discussion of the definition.
terms. He offers an arresting account about the nature of capability on philosophical grounds – justice, equality, or rightness, in relation to his capability framework. Moreover, it is important to stress that Sen’s approach is deliberately a flexible, open-ended framework rather than a fully fleshed out theory ready for practical application. Initially, for convincing the public and policy-makers, Sen opposes the idea that a simple combined measure of human development is needed. In his opinion, nothing about human development can be exactly measured. His reservation is mainly to do with the difficulties of capturing the full complexity of human capabilities in a single index. No one can be sure that believing a combined measure as a true evaluation can always make it true. However, later on, in the face of reality, he is persuaded that only a single number could shift the attention of policy-makers from material output to human well-being as a real measure of progress (United Nations Development Program, 1999).

On top and above the evaluative aspect, one of the most difficult tasks in applying the capability approach is deciding which capabilities are most important. In this connection, our beliefs or intuitions may often be wrong because the range of human capabilities is infinite. The value that individuals assign to each quality of capability can vary considerably. What qualifies as a critical or strategic capability varies from one person to another. Even if some capabilities deserve greater public attention than others, the relative importance of capabilities can vary with social context and roles of individuals. Thus the task of capability specification must relate to the underlying motivation of the evaluation exercise as well as dealing with the social values involved (Sen, 1989).

Assessing capability maturity and proactiveness

In Sen’s work, the term human agency represents people’s ability to act on behalf of goals that matter to them. This aspect of freedom, he argues, is a core ingredient of social change. “The people have to be seen … as being actively involved – given the opportunity – in shaping their own destiny, and not just as passive recipients of the fruits of cunning development programs.” (Sen, 1999a:53). But how fruitful is the capability that we have developed? How proactive are we?

As far as measurement is concerned, assessment of human capability seems surrounded by a mystique of undefinability. Yet quantitative measures of capability, in the sense of people’s self-evaluation of whether or not they are capable to perform or act, is by no means unachievable empirical realm. Some such measures seem to be comparable and robust across cultures. A closely related stream of research places emphasis on explaining and predicting the outcome of effectiveness in various occupations, often with a primary emphasis on managers and leaders (McClelland, 1973; Boyatzis, 1982, 1984; Luthans et al, 1988; Spencer and Spencer, 1993). In
this competency approach, specific capabilities are identified and validated against effectiveness measures or indicators. Some studies are clustered and, with heuristic rules, indicators are often inductively devised and then articulated as competencies. Without a well grounded theoretical or methodological foundation, it is, in a sense, the measurement of the *ends* instead of the *means*.

To overcome some of the above evaluative problems, a method of measuring self-efficacy as an indicator of capability maturity is proposed. Instead of directly measuring knowledge, abilities and skills, the method is based on a set of different assumptions strongly grounded on Albert Bandura’s Social Learning (or Social Cognitive) Theory (Bandura, 1986, 1997). The instrument was designed to assess the direct experience of individuals by examining their self-efficacy beliefs. As will be explained in the next chapter, the direct experience of people exemplifies the first source of self-efficacy, or performance accomplishment (Bandura, 1986). These experiences are essentially career related. The methodology will be introduced in Chapter 7, and an empirical investigation using this approach will be presented in Chapter 8.

### 5.5 Chapter summary and discussion

Human capability and its functioning are discussed here using a dialectic framework. Its complexity and related theories (theory of action, contingency theory and resource-based theory) suggest that the pursuit of capability development is a worthwhile goal. The proposed dialectic framework is a simplistic view representing the ways of relating the key dimensions of ‘capability development’ and ‘human functioning’. While provoking thoughts about the criticality of capability building, the framework can, at the very least, provide a problem space for managers or practitioners to look at how they currently make use of their capability.

Ontologically, it is assumed that the reality of how things work will be dependent on our various actions and consciousnesses of our strategic goals. It also means that each person’s interpretation of what is most needed for capability development is situational. The requirement and action to be taken will depend upon the ‘reality’ of his/her situation and influences imposed by the surrounding environment. However, it is my belief that our future reality can be shaped by adopting a vigorous capability approach similar to the one advocated by Amartya Sen and Martha Nussbaum. Such an approach points aptly to what we are actually able to do and to be, as learning is fundamentally about what we learn to be as much as about what knowledge we acquire. The approach emphasizes the flourishing of human capability for better functioning and well-being. It suggests a view of capability development as more than just for economic development, and incorporates an implicit view of capability development and resource-based theory. It is, above all, a domain of activity requiring re-thinking and judgment not only about what has been done but a guide to future action.
Epistemologically, while some theories and practices can be learned from others (42), there is a need for ongoing research that informs our practices and continually refine our skills through a rigorous process of self-reflection (Argyris & Schön, 1974, 1978; Argyris, Putnam & Pitman, 1985). It is also true of our learning and the way we develop our capabilities, which entail a good understanding of the theories-in-use. These theories include contingency theory, action theory and resource-based theory. While the resource-based or resourcist perspective is an important standpoint, it is not only about the strategic significance of how human resources are managed. A resource-based perspective has also been adopted for purposes of capability transferability and industrial analysis. Its strategic analysis of barriers to organizational success, goal-setting, social conversion factors, and evaluative aspect of the approach all help to explain why capability development is receiving more attention. Having said that, human resources and capabilities are only half of the equation. The critical issue is contingent upon how they are used as well as the quality of the actions taken.

The current “planning, organizing, leading, and controlling” – one-size fits all approach may be best suited in stable organizations that are less sensitive to complex, dynamic changing environment. With this particular traditional approach (see Chapter 3), many managers fail to appreciate the criticality of time in the acquisition and accumulation of capabilities and the fact that they need to be constantly maintained and developed for creating the capability edge.

In dealing with safety at work, people should have a reasonable understanding of the ways of relating risk to safety. By understanding how small things could lead to enormous consequences (see Chapter 2), safety management should be taken as a strategic issue even though such requirement is not externally imposed by law. In dealing with strategic issues related to risks, it is suggested that managers or practitioners need to include essential parts from each perspective that are relevant to their situation and apply them using a contingency approach in order to expedite internal resources and capabilities to cope with long term safety needs.

The strategic capability approach and conceptualizations that I develop in the next chapter will draw on the above theories in cognitive science, strategic development, organizational theories that stress the possibility of improving our ways of knowing and acting. The approach will not be reductionistic, disjunctive or abstract, but attempt to grasp the complexity of knowing the world that recognize the validity of a plurality of ways of relating and how one thing leads to another. Generally, what I’m trying to postulate is that capability development is an important strategic option fundamental to long-term safety management success. From this point of view, creating a virtuous cycle with leveraging effects “in which

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42 Learning both formally (e.g. through education and training) and informally (e.g. through our worldview that represents our experience about the world).
specialization leads to higher common multiplies, higher multiplies to greater specialization” (Penrose, 1959:73) can lead organizations in their pursuit of sustainable growth. Perhaps, the proposed strategic capability approach may be able to provide practical guidance with thinking similar to that advocated by Amartya Sen.
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6.1 Introduction

The capability approach of Amartya Sen (1993) is the foundation on which the theoretical framework of this study is based. In developing the framework, the methodological issues were addressed. These included the rationing of strategic choice, human resource development, critical functioning, state of well-being and the personal and social conversion (or contingency) factors that affect the way in which the approach was operationalized.

The notion of strategic capability development is introduced in this chapter as one of the major concepts in an effort to find adequate possibilities for managing safety at work. It is a kind of strategic development that meets the needs of the present without compromising the ability in dealing with strategic issues and changes in the long run. The capability approach connotes “development” as a process of change, which involves the contingency principle of criticality (43) and strategic choices to guarantee the basic safety needs of human being are met.

Sen’s theory of human development as capabilities expansion is a starting point for the construction of my conceptual model. Intuitively, the idea that the purpose of development in matters of safety is to improve human well-being at work, and that meant expanding as far as practicable the range of things that a person could be and could do, and the entitlement that a person could be fulfilled. For example, in organizational context, it is a person’s basic entitlement to be safe and well-protected against workplace hazards, to be knowledgeable, to participate in the work of assuring safety and health. From this point of view, capability development is also about removing obstacles and constraints to what a person can do, such as lack of access to risk information, lack of safety training on safety critical issues, or lack of participation freedom in decision making related to risk.

43 Contingency principle of criticality: see Section 4 of Chapter 4 in my discussion about criticality.
This chapter also presents a contingency framework for capability development. The purpose in doing so is not to redefine the principles in depth or to recognize every aspect of the capability development issues, but rather to examine capability development through the lenses of Amartya Sen’s capability approach and other related theories.

**Contingency as a radical concept**

What is contingency? To think about the word “contingency” in my own language (as a Chinese) is of little use to clarify the matters. It seems to me the word get lost in Chinese translation. It appears to be a vague term with a vast diversity, possibility, and something not yet known but it is there in reality. However, as a semantic question, “*reaching consensus about ‘the meaning of contingency’ means reaching consensus about the things we want to do with the notion of contingency.*” (Schedler, 2004: 4). Here contingency is referred to as the strikes of catastrophe, be they natural or social (ibid: 5). It refers to something conditional and situational. Therefore, based on the radical concept, the framework derived from Sen’s approach can be conceptualized as a contingency model based on a radical concept that involves conditionality (e.g. present state of well-being) and highly variable degree of uncertainty (e.g. future possibilities, opportunities and threats) (ibid: 7). Given the radically abstract nature of contingency, the proposed conceptual framework provides a roadmap through multiple locations of contingency: conceptual and practical applications, strategic goals and actions, states of well-being and achieved functionings, causal relations, individual and organizational learning.

**Strategic Capability Development (SCD) as a conceptual model**

As a model, SCD explicates that the process components and elements are connected and dependent on each other. It takes into account and is contingent on the working environment and its social factors. It acknowledges the fact that social distress, such as accidents or disastrous incidents, may cause enormous consequences. Such social factors also implicate individual and organizational responsibility.

As described elsewhere in this thesis, capability development efforts are seen as contributing to a portfolio of activities (*Table 4-3: Critical Capability Inventory*), the elements of which are:

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44 See Chapter 2 – Understanding safety and risk: how risks are coming into being.
45 See Chapter 5, Section 2 – Relating contingency perspective and action theory to capability development.
46 See Chapter 2 – how small things can lead to enormous consequences.
47 See Chapter 2, Section 5 about risk consequences and responsibility.
(1) maintaining and improving capabilities for diverse safety management contingencies \(^{(48)}\); 
(2) shaping the working environment with safety proactiveness \(^{(49)}\); and 
(3) assuring strategic adaptiveness in response to whatever risk challenges emerge.

**Capitalization of abilities**

To *capitalize* our abilities to achieve a desirable state of well-being, the content and methods of capability building should be designed to help individuals acquire the critical skills, essential knowledge, positive attitudes and behaviors needed to access and expand the inventory of existing improvement and participation opportunities. Thus the practice of capability building places a premium on helping individuals and organizations learn how to work collaboratively in the construction of knowledge for building critical capabilities \(^{(50)}\) to deal with changes and uncertainties.

Based on the framework and theoretical assumptions, two hypotheses are then developed at the end of this chapter to postulate their general relationships, predicting respectively a positive relationship between the clusters of critical capability and goal-setting capability (H1), and a positive relationship between the clusters of critical capability and level of proactiveness (H2). [See Section 8 – Hypothesis Development]

### 6.2 The Strategic Capability Development (SCD) Approach

In the previous chapters I discussed and argued that capable organizations are essential to foster the development of capable individuals. Capability building emphasizes nurturing the linkage between individual capability development, organizational capability development, as well as human capability development in a wider context. To a certain extent, the process of development is applicable to almost any sector of business, industry and education. Because of its widespread implication, applicability and relevance, I venture to coin a new word called “**Capagogy**” to signify the importance of capability building and development as a discipline of study to advance human capability and functioning.

*Capagogy* may live up to the opportunity of becoming or can be thought of as a discipline of learning reflecting a growing, *practitioner-based* understanding of the high-order skills and competence, which require extensive domain knowledge, and the ability to engage in formal and informal learning, self-organizing and critical reflection. More specifically, by

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\(^{(48)}\) As implicated by the contingency theory (See Chapter 5)  
\(^{(49)}\) See Chapter 2 for discussion on *proactiveness and proactivity*.  
\(^{(50)}\) See definition of critical capability in Chapter 4.
drawing on a wide spectrum of learning theories and practices, *capagogy* can become a discipline of learning science that provides enhanced learning opportunities for people to develop their human capability, for example, learning to learn, learning to think, to become creative and innovative, learning new skills for a new world, so on and so forth.

Within the context of this study, the focus of the approach is to improve the process of capability building. Up to this point, it would be useful to summarize the ideas and the findings of the previous chapters to make sense of capability building in professional context:

1. Capability (cap-ability) is the ability to capitalize\(^{51}\) *ability* timely for achieving a particular purpose or human functioning individually or collectively in a specific context or environment.

2. Capability building should be viewed as a critical process of development by which critical capabilities are identified and built, with specific purpose in response to changes and long term development needs.

3. In social or organizational context, a capability building process should offer participation, improvement and organizational learning opportunities for both individuals and their counterparts.

Their applicability is not limited to formal education setting, they apply to virtually any sector of our professional life. One might draw on the principles of Sen’s capability approach (1985, 1985a, 1993, 1995, 1999a, 1999b); Bandura’s social cognitive theory (1977, 1986, 1988, 1991, 1997, 1999); Knowles’ *andragogy* (1984), Vygotsky’s cognitive apprentice theory (1962, 1978), Brookfield’s collaborative and participatory learning (1986), Argyris and Schön’s action theory (1978), Peter Senge’s learning organization theory (1990), etc. to justify the above claims. Some reflections on their theories or concepts in relation to the SCD approach will be discussed. This will be the next task after the work on the approach is devised.

### 6.3 Capability building in safety management

At the heart of human capability building is social justice that provides equal, diverse opportunities for learning and promotion of appropriate human functionings (Sen, 1993).

As defined by Amartya Sen: “A *functioning* is an *achievement*, whereas a *capability* is the *ability to achieve.*” (Sen 1987a: 36).

However, the theory of human development needs to be more than a theory in social or welfare economics. As pointed out in the previous chapter, Sen has extended his capability approach considerably in *Development of Freedom* (Sen, 1999a), but the essence of welfare economics is

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\(^{51}\) Capitalize: to turn something into one’s advantage or benefit (Dictionary.com); to draw advantage from (WordNet Dictionary).
retained. As discuss elsewhere in this thesis, I would think his approach and its basic philosophy are helpful in other social or organizational contexts in addition to Sen’s original intention.

**Managerial capabilities for managing safety at work**

What is capability building in the context of safety management? As suggested by the working definition that I’ve defined in Chapter 3, building safety management capability, is essential in the institutionalization of a combination of technical, organizational or combined management functions and organizational capabilities, which can reduce the probability and/or consequences of potential hazards in a specific working environment. *Well-being* in Sen’s language refers to a personal situation in terms of *achieved functionings and goals* (Sen, 1993), as well as those functionings achieved by others. It should however be distinguished from the notion of agency (52), which is more inclusive as it relates to the commitment or willingness to actually support other people in pursuing their worthwhile goals. In the context of workplace well-being, well-being refers to the ability to perform safety tasks which are necessary to achieve internally the defined safety goals and externally the obligations imposed by law.

The intent of government regulators to impose by law a self-regulatory safety management approach for the protection of people at work has led to a search for different notions of how a desirable state of safety is achieved. However, “by law” and “self-regulation” are literally conflicting terms. The traditional approach of legal compliance to maintaining a well-being state of working environment on a self-regulatory basis, in fact doesn’t account for the diversity under different contingency circumstances.

On a contingency basis, there is a basic need for an organization to develop more sustainable well-being of workplace safety. However, the very notion of capability building is contingent on the critical issues as highlighted above. It depends on the capability of an organization (and its people) to understand the internal contingency factors and externally-imposed obligations so that they can make the right development choices. This will require scientific, technological, organizational, and specific skills or expertise, for example how workplace hazards are assessed, how to determine the probability of their occurrence, and how control measures are devised. By taking a resource-based perspective, one way of looking at the above issues is to regard safety management as a set of critical managerial capabilities, which have to be developed over time with *deliberate practice* (Ericsson, 1996). Given a set of well developed capabilities, we have to operationalize them and put them into effective use.

52 The condition of being in action; operation. The means or mode of acting; instrumentality.
Operationalization of the capability building process

One might wonder what is meant by operationalization of capabilities? This unattractive word “operationalization” is pretty abstract. In a very general sense, according to the dictionary (53), it means putting something into operation. Theoretically, by operationalizing we mean the process of transforming a theory (or a set of theories) into something of practical value. Operationalization suggests that the mode of transformation consists of a sequence of operations (Comin, 2001), including:

1. theoretical inclusion,
2. measurement,
3. application, and
4. quantification.

This should be understood that, to operationalize a theory, it should not be confined to quantifying the theory. Instead, it should be seen in a wider framework of using the theory in real world applications.

Some critics, for example, Roemer (1996) and Sugden (1993), suggest that the multidimensional context-dependent nature of Sen’s approach might have prevented the approach from having operational significance. However, Sen himself has quite often attached a strong practical meaning to his work. For instance, he himself and together with Jean Dréze have undertaken extensive empirical work from a capability perspective, studying issues such as development and mortality (Sen, 1998). Despite these efforts, for instance Sen’s publication on Commodity and Capabilities in 1985 and his subsequent work, the number of empirical applications is still quite limited (Robeyns, 2000).

To some extent, Sen acknowledges the concerns about empirical difficulties in operationalizing his capability approach (1985a: 46 and 1992: 52). He acknowledged the fact that (1999a: 24) “[t]he extensive coverage of freedom is sometimes seen as a problem in getting an ‘operational’ approach to development that is freedom-centered. I think this pessimism is ill-founded”. Thus, one can see that operationalization in regards to its application and its practical use remains one of the most challenging aspects of Sen’s capability approach.

In using the capability theory, for example, Hamel and Prahalad (1990) point out that people are the competence carriers. Although they do not particularly refer to Sen’s capability approach, it boils down more or less to the same thing. They claim that core competence derives from corporate-wide learning process, integration of diverse skills and streams of technologies.

53 Webster's New Millennium Dictionary of English, Preview Edition (v 0.9.6)
work organization, creation and delivery of value and capability for inter-organizational cooperation. The key to that, they argue, is to develop strategic architecture featuring a corporate wide map of core competences (for incident, risk assessment, risk control and analysis skills in dealing safety at work). Such architecture, in my opinion, is well positioned to take advantage of speed, flexibility, and responsiveness. This kind of architecture shows how we might put our theory into operation, but, in a fairly loose way.

Similarly, Kidd (1994) and Goldman et al. (1995) describe people as the critical resource that enables an organization to adapt and respond quickly to changing requirements. I share Kidd’s idea that critical capabilities are associated with an organization’s service capability. The critical capabilities of individuals include their skills, knowledge, attitude and expertise, as well as adaptiveness and responsiveness. Through investment in appropriate training and education, workplace learning opportunities, and participation opportunities, the critical capabilities of individuals within an organization can be upgraded and re-focused for optimizing the use of and investment on human resources.

Why Amartya Sen’s capability approach

An overview: The perspective of Sen’s approach has been widely used for analyzing a number of social and ethical issues: commodities and capabilities (Sen, 1985); well-being and poverty (Sen, 1992); welfare, development and freedom (Sen, 1991, 1999a); ethics and economics (Sen, 1987a; Qizilbash, 1996); living standards and development (Sen, 1987b); inequality and social choice (Sen, 1992, 1995, 1997); gender bias and sexual division, justice and social ethics (Sen, 1993); as well as philosophical and methodological issues (Sen, 1979, Sen & Anand, 1994, 2000).

A similar notion of capability approach has also been widely adopted for different applications or studies, for example, women and human development (Nussbaum, 2000), gender inequalities (Robeyns, 2001), feminist economics and gender analysis, (Agarwal, Himphries & Robeyns, 2003), welfare economics (Kuklys & Robeyns, 2004), social science (Bhargava, 1992), social justice (Fraser, 1998), and philosophy (Pogge, 2002). Other contemporary work (Dieng et al., 1996; Davenport & Prusak, 1998; Zack, 1999; Simon, 1996; Verkasalo & Lappalainen, 1998; Nonaka & Takeuchi, 1995; Grundstein & Parthes, 1996; Qizilbash, 1996; Alkire, 2002), using Sen’s capability approach, can also be found. Because of the widespread application of Sen’s approach, its principles have been well proven. Although Sen’s approach has never been used in the discipline of safety management, which involves some form of social and ethical obligation (see Chapter 1), I venture to explore how Sen’s approach can be applied in the context of occupational safety and health.
Most of the theoretical issues concerning “capability approach” have been investigated in Sen’s work and in the related literature (Sen, 1979, 1985, 1987a, 1987b, 1991, 1992, 1993, 1994, 1995, 1997, 1999, 2000), and it is not the point of this research to reconsider them. Rather, here I am trying to explore in this chapter the possibility of mapping the development of managerial capability according to Sen’s view.

The “capability approach” conceived by Amartya Sen (Nobel Laureate in Economics) is perhaps the most influential account of human development (Qizilbash, 1996). Sen considers economic growth and utility or happiness maximization are not sufficient objectives for development as its end. Rather development should be a means to improving human well-being and agency. Sen’s approach is based on two grounding concepts: capability and functioning. The capability approach combines politics, ethics, social justice and economics. His approach explicitly acknowledges the value judgments inherent in development and social arrangements. In other words, the goal of development, according to Sen, is to expand capabilities or valuable freedoms. Hence, economic, political, legal, and other social arrangements should be evaluated according to how they expand people’s capabilities.

In regard to the standard of living, Sen points out another notion, that involves the aspects of well-being regarding “the nature of his own life, rather than [from] ‘other-regarding’ objectives of impersonal concerns” (Sen, 1993: 37). The core characteristic of Sen’s capability approach is its focus on people’s capabilities, that is, what people are effectively able to do and to be. This contrasts with other philosophical approaches that emphasize on people’s happiness, or on theoretical and practical approaches that concentrate on income, expenditures or consumption.

As far as human functionings are concerned, Sen contends that: “functionings represent part of the state of a person – in particular the various things he or she manages to do or be in leading a life” (Qizilbash 1996: 2). Since the capability approach is concerned with valuable functionings the agent can achieve. “the freedom to lead different types of life is reflected in the person’s capability set,” where the capability set is the set of beings and doings which she can achieve. This consideration allows a formulation of Sen’s contribution to social and ethical development. This conception of development is summarized by Qizilbash (1996) that human development takes place if and only if there is freedom for unrestricted expansion in the capability set of people, which is “consistent with the demand of social justice” (abid: 3).

**Capability development as an agent of change**

Based on the concept of Sen’s capability approach, we should look at capability as an agent of change. When dealing with capability development, Sen argues that it would be more appropriate
to refer to the notion of agency. “Agency” takes into account a real social and ethical commitment implied by the notion of ongoing capability development for achieving a desirable state or level of capability maturity. The notion of agency, according to Sen (2000), suggests that people are not simply human beings with needs. Very often, they are “agents of change who can – given the opportunity – think, assess, evaluate, resolve, inspire, agitate, and through these means reshape the world” (Sen, 2000: 1). His view in this respect is more generally in agreement with Adam Smith’s analysis (54) of “necessities” (Sen, 1999a: 24), concerning the ability of people to choose a reasonable life. Based on this perspective of basic human necessities, capability development is also a moral as well as an ethical concern.

In my view, the capability approach can be generalized to become an interdisciplinary paradigm. Because the underlying philosophy and its vocabulary is not too difficult to understand (by those who are not mainstream economists), the capability approach offers a unique chance to enhance policy making with a much broader social, ethical and equitable perspective. So far, however, Sen’s capability approach is much more ‘theoretical’ than ‘empirical’. Its methodological principles do not naturally lend themselves to highly abstract mathematical modeling.

Nevertheless, as exemplified by many applications of Sen’s capability approach, its diversity and applicability are rich. But this is done at the costs of not being able to construct simple evaluation models, nor being able to conduct full evaluation to construct a widespread of rankings in relation to capability development. The more an economist values and develops models with a minimalist approach, the more difficult it will be to work within the capability paradigm in a non-reductionist way (Robeyns, 2002).

As the individual is regarded as an active agent for capability building, we can assume that each of us develop our personalized approach to integrating different types of theory and knowledge and put them into use. Sen, however, looking for a much broader notion of well-being, has developed an approach focused on the development of capabilities and human functionings: the capability approach (Robeyns, 2000; Grasso, 2002). Based on the arguments and discussions in previous sections, such an approach, I think, is useful not only for making things better but also help understand how capabilities affect people’s well-being and functionings in their daily work. Within the context of safety management, I use the term “well-being” interchangeably with desirable state or healthy and safe working condition, instead of the more general concept of “well-being” according to Sen’s capability approach.

54 “It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, ...”
A resource point of view

Development from a capability development perspective implies the broadening and enhancement of human potential which implicates that individuals’ ongoing growth is the end rather than the means. From a resource point of view (55), this notion of human development should be focused on the expansion of learning opportunities (Spencer, 2002) and of the real human safety needs in order to cope with the basic values for the common good. In short, the approach is concerned with the expansion and enhancement of human capabilities (Sen & Anand, 1994). This focus has profound origins in philosophy, which is also soundly based on a traditional philosophy of human capability development: “The approach reclaims an old and established heritage, rather than importing and implanting a new diversion” (Sen & Anand 1994: 3). It is nothing new but, instead, it is a matter of focus in our strategic thinking about our well-being and how this can be improved.

Sen in his capability approach suggests that human development coincide with the expansion of capabilities “… development that promotes the capabilities of present people …“ (Sen 2000: 5). Similarly, capability development in professional context such as safety management is to build on current capability for the purpose of protection of human rights – the right to know and the right to respond to anticipated risk. In a practical perspective, Sen suggests that “in detailed application, a general idea of this kind can, of course, be combined with more precise articulation” (ibid: 3). Therefore based on this practical notion of human capability development, in the following sections I outline a possible operative route to map managerial capability development as intended in the capability approach.

6.4 The resource-based approach to strategic management

The organization is seen as a collection of resources, the effective utilization of which determines the relative positioning of the organization in its strategic development (56). Internally generated capabilities are seen as critical to an organization’s performance. The expanding capacity of capability development is also a strategy externally oriented in response to opportunities (Whittington, 1993).

There is a widespread assumption in resource-based theory that capabilities are ultimately adaptable to management’s cultivation and control. The major problem is concerned with identifying such capabilities and developing appropriate managerial responses. However, there are reasons to question this assumption because some of us fail to recognize the problem of

55 See discussion of “Resource-based Theory” in Chapter 5
56 See also Chapter 4 for a brief account of literature review on capability development.
appropriateness. This is partly to do with our limit in understanding the importance of strategic choice.

Given this kind of argument, we should be able to contend that critical capabilities meet the criteria to be seen as a resource providing competitive advantage or organizational success (Flood & Olian 1995). These critical capabilities, if well developed, add positive value to the organization because capability building and development have the potential for knowledge and skill renewal and avoidance of obsolescence. This is made possible through appropriate training and personnel development, and for much broader capability transferability across a wide range of activities, including how we deal with safety issues in our workplace.

But the issue of criteria brings us back to the thorny issue of appropriateness – How do we determine the critical capabilities in specific context? The answers to this question were given in Chapter 4. As reported in the meta-analysis, the findings suggest that capability development efforts are seen as contributing to a portfolio of activities (i.e. Table 4-3: Critical Capability Inventory), the elements of which are:

1. maintaining and improving capabilities for diverse safety management contingencies – as argued by the contingency theory;
2. shaping the working environment with safety proactiveness – as suggested by the discussion in Chapter 2; and
3. assuring strategic adaptiveness so that organizations in response to whatever risk challenges emerge – as contended in Chapter 3.

Relating capability to social factors

Capability development for safety management, within an organizational context, is defined here as “building on current capability at all levels to identify, mitigate and control hazards and risks for the protection of people from being injured at work”. This definition is drawn on the working definition that I derived in Chapter 3:

A safety management system is a systematic development and application of a combined set of technical, social, managerial functions and organizational capabilities, which can reduce the probability and/or consequences of potential hazards in a specific working environment.

To make optimum use of capability, one has to acquire core skill and capability sets through practicing key elements and then learning to put these elements together so that sequences of actions become automatic and attention can be devoted to wider issues. The capability can then be extended. Once the primary capabilities have been developed, the higher-level goals can be attempted. Highly skilled and capable individuals or teams know almost intuitively what is and
what is not important, and they have the correct repertoire of responses available. They constantly look to discover what they do less well and practice in order to improve. The same applies to safety, and to safety management in particular, because the latter is a relatively new concept compared with the traditional safety norms.

When we look at the issue in a wider perspective, safety management involves social factors which are important aspects of a culture. For example, a safety manager may have abundant resources, but in a highly individualistic organization, he may be without networks of social or peer support. In another situation, a person may have very few resources, but because she is supported by a strong culture of sharing, this poor person may escape from scarcity of limited resources. These scenarios tell us that the capability approach sees cultural functionings as important well-being state in their own right. This can have important implications. For example, the advantage of a positive cultural functioning is that people can operate in with greater confidence and trust. Otherwise, people in matters of safety can only entrust themselves to luck or be closely managed by others in a negative or reactive way.

6.5 The SCD approach - making capability work

This section is intended to give a detailed account of how capability works and how to operationalize the SCD approach. By operationalization \(^{57}\), besides the given meanings previously defined, I also mean the steps between a theory and its empirical application (at least at some critical points). The purpose of this Section is to create and present a theoretical picture of the SCD Approach which resides partly in real life experience and partly in the empirical world. In other words, the proposed SCD Model is a theoretical image of the object of study. The target is to present the essential things, not everything we know about the capability development. It is a model that provides a simplified picture of reality. In the main, it contains some modifications to Sen’s approach but with operationalization in mind.

Modeling the SCD Approach

As explained elsewhere in this thesis, Sen’s capability approach has a well proven experience and international recognition. I therefore do not intend to reinvent the wheel. Instead, from an operationalization perspective, here I propose a strategic capability development approach (SCD) that would on one hand bridge, at least partially, the identified gap and on the other hand extend Sen’s capability approach to a wider context of application, especially in the field of occupational safety and health.

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\(^{57}\) Operationalization: Statement that denotes how the variable is observed and measured in a specific way; most variables can be operationalized in multiple ways.
Grounded on Sen’s capability philosophy, the concept of my SCD is illustrated in Fig. 6-1. Within this proposed framework, an organization or individual achieves a set of desired functionings when it has the critical capabilities to sustain coordinated deployment and development of resources in ways that help the organization achieve its strategic goals and desired functionings. By doing so, each organization or individual will have developed a set of critical capabilities through ongoing development and value-adding activities in pursuing its long-term goals, leading to the strategically important differences in the kinds of available resources.

In general, Sen’s capability approach requires the translation of commodities or services into actions and valuable functionings, from which the various combinations of achievable goals and objectives may be chosen (Sen, 1993). In other words, human resources, enhanced by personal and social conversion factors, allow the attainment of goals and enable appropriate actions to be taken. These goals and actions may be represented by the evidence of achieved functionings. Finally, the choice of a specific subset of functionings generates a given level of achievement, which in turn can eventually provide feedback with appropriate responses for adjusting the goals. Although I do not use the term “commodity or commodities”, the meaning of “human resources” is reflective on this term.

Sen suggests that at a practical level the most appropriate focus of attention should not always lie in the measure of capabilities. He also points out that “some capabilities are harder to measure than others and attempts to putting them on a metric may sometimes hide more than they reveal” (Sen, 1999: 81). Furthermore, the chosen vector of functionings could be seen as a basic valuation of the capability set which, depending on the appropriate choice of elements of the vector, can in turn be considered as the critical or valued elements. Based on these principles, a set of critical capabilities was derived by carrying out a detailed meta-analysis of relevant literature (the method and findings are reported in Chapter 4).

**The Strategic Capability Development (SCD) Approach**

The proposed model, as illustrated in Fig. 6-1, is a schema of representing the concept of the SCD that: the state of well-being is a function of achieved functionings resulting from the conversion of human resources into critical capability sets for the purpose of meeting the identified strategic goals.
In this model, it should be noted that the words, strategic and critical, are added here to emphasize the importance of strategic thinking and decision making throughout the process. Besides this emphasis, the concept is in general agreement with Sen’s capability approach. A general comparison is summarized in Table 6-1.

Table 6-1: Comparison between the proposed “Strategic Capability Development Approach” and Sen’s Capability Approach

<table>
<thead>
<tr>
<th>Sen’s Capability Approach (Sen 1993)</th>
<th>Capagogical Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freedom (as theoretical foundation)</td>
<td>vs. Flexibility &amp; Openness</td>
</tr>
<tr>
<td>Well-being in general terms</td>
<td>vs. State of well-being in specific terms, such as safety-optimization</td>
</tr>
<tr>
<td>Achieved functionings</td>
<td>vs. Achieved critical functionings</td>
</tr>
<tr>
<td>Freedom of choice</td>
<td>vs. Strategic choice</td>
</tr>
<tr>
<td>Vectors of functioning (capability set)</td>
<td>vs. Critical capability set</td>
</tr>
<tr>
<td>Personal and social conversion factors</td>
<td>vs. Conversion (or contingency) factors</td>
</tr>
<tr>
<td>Commodities or services</td>
<td>vs. Human resources</td>
</tr>
</tbody>
</table>

Another feature of the proposed SCD framework is characterized an open-system by which new strategic options of capability building is made. It is the process by which the organization or individual exercises its existing strategic options to create new strategies and strengths to deal with uncertainties, weaknesses and opportunities for ongoing improvements.

**Strategic Goals:** This extended version of Sen’s capability approach provides a framework for elaborating the challenges managers and safety practitioners face in pursuing “strategy as [both] stretch and leverage” (Prahalad & Hamel, 1990). The approach envisages that organizations or individual practitioners compete both by leveraging current capabilities and by finding ways to
‘stretch’ beyond their current capabilities. Similarly, the proposed framework of SCD requires stretching and leveraging our way of thinking individually and collectively in setting and coordinating strategic goals. In this process, managers and practitioners must not only choose a specific set of capability building and development, but must also determine the relative emphasis to be placed on each goal-seeking and decision making activity.

**Human Resources:** Sen (1993) defines resource as “capabilities” in human terms. The present study uses the term ‘resources’ to simplify the discussion. Amit and Schoemaker (1993: 35) defined resources “as stocks of available factors that are owned or controlled by the firm (organization)”. Wernerfelt (1984: 172) describes a resource as “anything, which could be thought of as a strength or weakness of a given firm (organization)”. After lengthy discussions and reviewing, we still can add more to justify the claim. In using the term “resource” here in the framework of SCD, I mean a strategic resource, that is, one that differentiates the organization strategically and creates critical capabilities to deal with future possibilities, opportunities and threats.

**Conversion (or contingency) Factors:** Strategic capability building entails strategic learning. It characterizes organizational learning as the detection and correction of errors, which may occur at different conceptual levels within organizations (Argyris & Schön, 1978). Learning occurs at a purely operational level when detection and correction does not lead to significant alteration of the organization’s goals. Strategic learning occurs “when error is detected and corrected in ways that involve the modification of an organization’s underlying norms, policies, and objectives” (ibid). It is strategic learning that helps us to cope with social and organizational changes.

**Critical Capability Set:** Collectively, a set of critical capabilities is the source of power that creates a force that allows an entity (e.g. an individual or organization) to act or accomplish a task or purpose. Therefore, the identification of variables of a critical capability set often involves the design of effective performance indicators or critical success factors. In considering safety research since 1980, it is apparent that these key variables or factors identified in the meta-analysis of literature have been confirmed as descriptors of critical determinants of safety success. [Details on how to identify critical capabilities and their related tasks are given in Chapter 4.]

**Achieved Critical Functioning:** Sen stresses the importance of the conversion of resources into achievements: a process which strongly depends on variable personal characteristics and social

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58 See Chapter 4, Section 4, about strategic learning.
59 See Chapter 3 – literature review on safety management.
circumstances. The main reason for his shift in attention from pure functionings’ to capabilities lies in the proposition that choosing is itself a valuable part of living. Therefore, critical capabilities are linked with the relationships that represent well-being and the strategic choices about how best the desired functionings can be achieved. The term ‘critical’ that I add here is to give emphasis on the need to be critical rather than having a ‘heavy system’ loaded with everything without considering its priority.

**State of Well-being:** The general model of well-being proposed by Sen (1999) is a non-safety model that has a great potential to assist researchers conceptually in adapting the approach to the specific needs of their respective research field.

In the model that I propose, the state of well-being is a function of the achieved functionings (e.g. ‘can do’ in dealing with strategic issues in managing safety at work) through capability building and development, where the conversions (or contingency factors) arise from personal and social/organizational characteristics. If we take a dichotomized view (see Fig. 6-2), we may regard well-being as a collective phenomenon and a function jointly achieved by an individual and the organization in which he or she is working within. More specifically, resources of the organization including the individual (for example, safety director, manager or safety officer in safety context) determine each achieved functioning, via the conversion factors which take account of personal, organizational and social diversities.

![Fig. 6-2: A simplified schematic representation of the SCD Approach](image)

Within organizations a hierarchy of capabilities may exist; elementary features such as individuals’ capabilities may contribute to the creation of another more aggregate level of functionings and states of well-being (such as organizational culture). It depends on:

1. how we deal with the contingency factors in order to overcome our weaknesses and organizational constraints;
(2) how we come to produce better, more convincing knowledge and abilities that make a difference; and

(3) how we help people to be able to make more informed choices about their actions.

Reference unit

To operationalize a theory or concept, it should be realized in a wider framework of using the theory in real-world applications. In this connection, Sen moves specifically in the space of ethical individualism. In his evaluation, he considers the individual as the only unit that counts when evaluating well-being states. However, he avoids reducing society to the mere sum of individuals and their properties, as set by ontological individualism (Sen, 1985). It is clear in his argument that, in the development process, the capability conversion factors are taken as the determinants that convert human resources into functionings. Similarly, from a theoretical point of view, I suggest that the reference unit of the capability approach should be narrowed down to individual level with particular reference to capabilities acquired and how they are put into use. It is in fact what operationalization means to suggest.

Given the modified approach of SCD, we should however be aware that a distinction of different social groups would be very important, and that any methodological approach should be in consistence with other theories about capability development as well. Such kind of awareness can be summarized by the following contingency statement about flexibility and adaptiveness made by Sanchez (1997):

“Creating [or converting] a range of available strategic options is a fundamental way of improving a firm’s strategic flexibility to respond in various ways to evolving opportunities or threats” (Sanchez 1997: 9)

6.6 Relating the SCD approach to other theories, concepts or approaches

The above discussions and justifications assert that the approach of SCD is consistent with Sen’s view of well-being and functionings. The argument is based on the premise that SCD use human capabilities as the basis to define the state of well-being. And the approach is contingent on social factors, including how people learn in a social context. However, the main difference is that, philosophically, Sen’s approach is centred around development freedom but the approach of SCD is essentially based on strategic choices (see Table 6-1). To further justify my claim of conditionality of contingency that SCD explicates, it would be useful to examine it from other perspectives.
In the following discussion, it can be seen that in comparing with other approaches or concepts of professional development (such as Chris Argyris and Donald Schön’s *double-loop learning*, and the profound idea of organizational learning), amicable consistence can also be found.

**Organizational learning and immaturity-maturity theory**

For 50 years, considerable progress and impacts have been found in the development of organizational learning theory. Notably, Chris Argyris has defined and vigorously developed organizational learning theories for individual and organizational development. More recently, Peter Senge (1990), Kim (1993), and Nonaka and Takeuchi (1995) have advanced the concept further to become one of the mainstream management strategies. These management theorists and philosophers have made a significant contribution to the development of our understanding of *organizational learning*. This insight has provided the underpinnings for organizations to foster long-term effectiveness.

Learning and capability development are closely linked with organizational effectiveness as suggested by Chris Argyris’s immaturity-maturity theory. Argyris’ early research explored the impact of formal organizational structures, control systems, and management strategies on individual development. Part of his work compares bureaucratic values that dominate most organizations with a more humanistic/democratic value system, and how individuals respond to organizational values. Applying his *Immaturity-Maturity Theory*, his research in the 1960s shows how formalized structures, rigid channels of communication, and prescriptive job design often causes organizational and personal ineffectiveness. Chris Argyris in his books “*Personality and Organization*” (1957) and “*Interpersonal Competence and Organizational Effectiveness*” (1962) suggest that directive management styles foster immaturity and dependency and that more participative management styles foster mature and active employees. Indeed, he goes beyond the individual level to suggest that an organization might be viewed "as an organism worthy of self-actualization" itself (1957: 58).

Critical reflection is a distinctive feature of capability development involving organizational learning. To think about capability we need to make the distinction between development as a process and as a outcome. Drawing from Argyris conclusions, Argyris and Schön (1978), in their book, “*A Theory of Action Perspective*”, put forward the *Theories of Action* showing how individual and organizational learning takes place. They suggest there is some mismatch between belief and action. Their findings suggest there is a split between how individuals think what they want to do and how they actually behave. In professional development context, Argyris and Schön (1978) also suggest two responses to this mismatch and
identify two dimensions to learning. These can be seen in their notion of "single-loop learning", and "double-loop learning". Structurally, by seeing capability development as a process of learning, the proposed concept of the SCD framework then resembles Argyris and Schön’s “double-loop learning” approach.

**Single-loop learning** is a form of low-order or surface learning stemming from direct experience. It occurs when mistakes, errors or constraints are experienced. It can be equated to activities that add to knowledge-base or organization-specific competencies but without altering much the fundamental nature of the organizational activities (Dodgson, 1993). Although the use of the notions of feedback is entailed, learning appears to be on the surface rather than involving deep insights. This kind of organizational learning has also been regard as non-strategic (Mason, 1993), lower-level learning (Fiol & Lyles, 1985), and adaptive learning or coping (Senge, 1990).

**Double-loop learning** is a kind of high-order or deep learning in the context of capability development. It takes place when the organization is involved in the questioning and modification of existing policies, goals, current practices and procedures. This kind of learning goes beyond detection and correction of errors or removing constraints as implicated by low-ordered learning from past experience. The articulation and constant practice of double learning facilitates cognitive development and the cultivation of desirable skills and capabilities (Salomon, 1993). In application to capability development, double-loop learning means changing the organization’s knowledge-base or organization-specific capabilities (Dodgson, 1993). In terms of organizational learning, double-loop learning is also called higher-level learning (Fiol & Lyles, 1985), generative learning (Senge, 1990), or strategic learning by Mason (1993). In Mason’s language, it is “the process by which an organization makes sense of its environment in ways that broaden the range of objectives it can pursue or the range of resources and actions available to it for processing these objectives.” (Mason 1993: 843). However, the notion of my SCD approach and the cognition process of strategic choice take us further to examine the organizational learning capability.

**Organizational learning capability**

We’ve learned from management gurus and theorists that organizational learning is more than the sum of the parts of individual learning (Dodgson, 1993; Fiol & Lyles, 1985). As a learning organization purposefully constructs strategies and structures in order to maximize organizational learning that leads to the development of capability edge important for sustainability and future positioning. Here are some definitions by key writers about organization learning that informs capability development:
“The essence of organizational learning is the organization’s ability to use the amazing mental capacity of all its members to create the kind of processes that will improve its own” (Nancy Dixon 1999)

“Organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to learn together” (Peter Senge, 1990)

In his book “The Fifth Discipline”, Peter Senge (1990) elaborates on the characteristics of a learning organization such as a clear vision, shared mental models, personal mastery, teamwork and an experimental learning culture as key features that can be found in such learning organizations. This growing body of literature attempts to describe the kind of management practices and organizational characteristics of such organizations (Goh & Richards 1997; McGill, Slocum & Lei 1993).

Drawing from the wisdom of these theorists, developing capability also means learning in chaotic situations. It calls for organizations to model their structure as a living system rather than a mechanically controllable program. Acknowledging chaos and uncertainty enables people to experience chaos as a process that is creative rather than destructive, and to embrace diversity as a pathway from chaos to order (Hock, 1995) (60). By practicing organizational learning, an organization and its individual members do not lose out their capabilities even when members leave the organization. Sustainability of capability and business continuity are therefore maintained.

Although organizational learning is not the focus of this study, it would be useful to discuss how an organization would know if its systems are growing healthily toward capability maturity. Based on what I’ve learned from an international conference on “Learning Organization” in London, 1998 (facilitated by Peter Senge) as well as the organizational learning approach that we’ve been trying to promote in my organization since then, I often use this list as a diagnostic framework:

1. Is there a clear vision and a set of organizational goals to guide and support people’s effort and development?

2. Is the organization moving toward greater trust and interconnectedness of people, ideas and information?

60 “The Chaordic Organization: out of control and into order”, by Dee Hock, 1995. Dee W. Hock is founder and CEO Emeritus of VISA USA and VISA International. He has lectured throughout the world on innovation, quality, and the changing nature of commercial, social, and political organizations. His is one of thirty living Laureates of the Business Hall of Fame.
(3) Is the organization empowering staff effectively, becoming more consensual and
democratic?

(4) At the organizational level, is the organization becoming more capable of collective
learning and systems thinking?

(5) Is the organization a safe place, a practice field for exploring each person’s full potential
with a “no-blame” culture?

All the above questions are critical in a sense that systems and structures create support for
achieving organizational goals. While each question points toward an element for creating
authentic living organization, the growth of a learning organization is significantly enhanced
when these elements together are seen as a dynamic, living human system.

SCD, as illustrated in Fig. 6-1, is a system which calls for system thinking although not
specifically connoted. An invisible learning structure is implied by SCD. It generates or
influences people’s mental map which, in turn, affect their patterns of learning behavior (Senge,
1990). This invisible structure of capability development is more permanent than the events they
shape. The cognitive aspect of SCD changes system-level forces. Such dynamic changes
involve, for example, identifying, reinforcing, leveraging and balancing feedback loops and
organizational growth patterns.

6.7 Dimensions of capability development

As pointed out earlier (in this chapter) Sen’s capability approach in terms of its diversity and
applicability are rich. But this is done at the cost of not being able to conduct full evaluation to
construct a widespread of rankings or performance indicators in relation to human capability
development. One of the dimensions apparently missing in Sen’s capability development is the
rights of people in terms of safety and health.

Since it has become clear that economic growth does not necessarily benefit working
environment for the protection of people at work, a concern with risk reduction has become
increasingly important as a measure of development. In order to do that, there has to be some
criteria to determine whether people are capable of dealing with risk and safety in their
workplace.

Why are criteria needed? One fundamental reason for a serious account of criteria or
dimensions is to give secure epistemological and empirical footing to the multidimensional
objective of capability development. In the classical approach, safety was the metric that
conveyed value; therefore, the approach of performance improvement was to reduce injuries and
loss while at the same time minimizing cost. However, most discussions now acknowledge the
problems associated with the measurements of safety performance using the classical approach because there is insufficient knowledge about how effectiveness is properly defined (Mansley, 2002: 9).

A second fundamental reason is practical and relates to the need for effective methodologies for organizations to evaluate tradeoffs. A multidimensional approach to development as exemplified in Sen's capability approach requires many more value choices to be made explicitly (Sen 1993). This need for explicit value choices, I think, can be a strength or a certain kind of critical capability insofar as it empowers people to shape their well-being and safety functionings.

A third fundamental reason is that a set of criteria or dimensions can help groups identify unintended impacts. As the Marglins' book, “Dominating Knowledge”, points out, "a major problem is precisely that historically growth has expanded choice only in some dimensions while constricting choice in others" (Apffel-Marglin & Marglin, 1990). The implication is we should always keep in mind that there may be other choices or practical value to a set of dimensions of capability development.

Nevertheless, in reality, no practical methodology or tool can do away with hard choices without any errors. What is important is to have a self-regulating system for the detection and correction of errors, and as such it can help people make more informed, reflective choices. Here the SCD is characterized by these features of self-regulation and correction.

**Three basic dimensions of assessing effectiveness of SMS**

SCD suggests three variables within the concept of criticality. In larger organizations senior management, based on a clear vision of social responsibility, will need relevant information to determine that the safety management system elements are properly in place and operating effectively across the organization. So an identification and critical evaluation of strategic objectives and safety functionings will be required. This should also include information on the levels of proactiveness that enable decision making in regards to implementation of risk control measures. Therefore, for the treatment of SCD, I suggest the use of three variables backed by the concept of “criticality” \(^{(61)}\) and “strategic choice”:

1. safety functioning
2. critical capabilities
3. proactiveness

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\(^{(61)}\) See Chapter 4 (Section 4) for critique of “criticality” and its role in capability development.
Taken it all together, measuring *safety functioning, capability, and proactiveness* effectively provides information on three dimensions of the process maturity. This is illustrated in Fig. 6-3. The aim would be to be in the dark shaded area (i.e. high capability and proactiveness) with focus on critical functionings in order to optimize the performance outcome.

This matrix provides management with a way to gauge performance which can be applied at different levels. For example, looking at a specific safety management function (e.g. training and personnel development) or risk control system (such as entry into confined spaces), or looking at a range of management arrangements and risk control systems at a particular site or across the organization.

**The role of indicators**

The term “Performance indicators” is a well-defined in many business and industrial sectors, for example, performance management, technical analysis, public administration, academic performance, research evaluation, etc. In practical terms, management assesses effectiveness, improvement or success by indicators. Theoretically, we may address the issues of indicators, which “facilitate concise, comprehensive and balanced judgments about the condition of major aspects.” (Olson 1969:97) However, in assessing effectiveness of safety management, there is a widespread agreement on this area. “*In terms of [safety] indicators, there was general consensus that relatively small number of indictors – with 5 to 6 being generally thought appropriate*” (ibid: 9). One of the key findings of HSE also states that:

> “Management indicators were generally seen as very important but there was little clear understanding of which specific indicators were most important. Many of the debates in H&S management today are implicitly reflected in the views of investors, including matters such as the importance of a safety culture, the use of audits etc. The challenge is to find a way to highlight good management practice simply.” (ibid: 11).
Mansley (2002: 19), in his report to the Health & Safety Executive, suggests that the potential main indicators that organizations search for are: (1) Policy indicators, (2) People indicators, (3) Process (management) indicators, (4) Reporting indicators, (5) Performance indicators, and (6) Verification indicators. Unfortunately, none of the indicators addresses the importance of management or people capability as a critical human resource consideration.

**Indicators as proxy of capabilities**

In SCD, a simplified dynamic view can be seen. Capability growth is in fact the only lever that can move the system toward new equilibriums over time.

In modeling capability indicators, from a perspective of capability approach, the variables must represent the capabilities necessary to achieve the desired functionings. The selected indicators or indexes ought to be determinants of the level of capability maturity. They must represent “good and services which are inputs in the production of well-being” (Dasgupta, 1999:11), since their purpose is to measure the means by which outcomes are achieved, and not outcomes themselves. Relying on the outputs of well-being or desirable state, would provide “performance” measures, while, in a sense, we should measure performances in the space of achieved functioning as well as what people can do and what they can’t do (Mansley, 2002).

**Indicators as a proxy of conversion (or contingency) factors**

In transforming capability from one level to another, inevitably, personal and social conversion factors are involved. These contingency factors are the catalysts that determine the degree of conversion of human resources into service capability. In Sen’s vocabulary, the process is about the conversion of commodities into functionings. These factors are contingent on the surrounding environment in which the process takes place. The process of conversion or transformation suggests that individuals cannot be considered only in terms of the resources they have. They have to be treated also in terms of their ability and opportunity to convert their resources into valuable being and actions. “Even if it is accepted that everyone may need the very same resources of primary goods to pursue their diverse ends there still remains the ‘conversion problem’, to wit, interpersonal variations in the functional relation between resources and achievements.” (Sen 1994: 335).

Interpersonal variations, from a resource-based perspective, may have impacts on the conversion process. One of the major strengths of the capability approach is that it can account for interpersonal variations in conversion of the characteristics of the capabilities into functionings (Robeyns 2000: 6). According to Sen’s capability approach and other related theories, one might argue that personal and social conversion factors play a vital role in human
capability development. For these “conversion or contingency factors” they are the cornerstone of the proposed contingency model of SCD although a consideration of capability criteria and strategic choices would drastically increase the normative strength of the model.

The proposed SCD is socially constructed but managed with strategic thinking. It involves strategic choices about what is to be achieved. If we assume that everybody can convert resources into functionings and capabilities at the same rate with the same outcome without strategic planning, there would be no point in defining well-being “in terms of a person’s ability to do valuable acts or reach valuable states of being” (Sen 1993:30). In one sense, it seems apparent that SCD is socially constructed. The capability transformation issue lies in the fact that it allows the process to account explicitly for individuality, diversity, complexity and dynamic changes.

6.8 Hypotheses development

My thesis, which relies on ‘contingency’ theory, (see Chapter 5, Section 2) is that capability development determines the level of achieved functioning, which, in turn, determines the state of well-being. From the sets of potential contingency variables, the thesis confines itself to the consideration of strategic choice of critical capability sets. These variables exert a major influence on safety management activities, as exemplified by the notions of goal-setting, proactiveness and critical capabilities. To operationalized SCD, a set of critical capabilities (see Table 4-3) have been generated to guide people’s learning and action. These include three sets of strategic capability (i.e. goal-setting, risk management, and safety training) and two sets of operational capability (risk communication, and ‘operation and administration’)

Assumptions in assessing managerial capability

To render the richness of the model structure, in the following chapter, a detailed account of the functionings and critical capabilities will be analyzed in the context of safety management. But, before proceeding, I would like to make clear the basic assumptions of the proposed contingency model that:

(1) the choice of all elements of the model is heavily constrained by the validity of the data available \(^{(62)}\);

(2) the most important ingredients that provide a leveraging effect are the ones referred to goals, strategic choices and human capabilities; and

\(^{(62)}\) See Chapter 4, Section 9, about critical capabilities and how they are derived.
(3) the cause-effect relationship between each conversion/contingency factors and its magnitude of influence are implicated by past experience.

**Strategy goals and critical capability sets**

Literature about capability approach reviewed in this chapter suggests that strategic choice is critically important, especially in dealing with capability building and development. The strategic choice approach is one of several methods used in facilitating problem structuring and learning processes (Rosenhead, 1989). It is also part of the decision-making process guided by goals and objectives. The process of goal-setting and strategic choice, as an essential part of the proposed SCD framework, is viewed as a continuous process: a process of setting priorities and choosing particular solutions strategically over time. The resulting choice and the rules so established can be regarded as a generalization of safety-maximization through strategic choice in goal-setting. They all have normative justifications, though the justifications may not be universally acceptable.

The process of choice and goal-setting shows their differential impacts on the optimal state of workplace well-being in terms of safety. The literature in this area suggests that if management or key safety personnel (e.g safety manager) wishes to stress effectiveness and responsiveness in managing safety at work, their management strategy should be designed to support these arrangements. For organizations pursuing a capability development strategy as a long term solution for safety optimization, they should pay special attention to goal-setting and strategic choice in identifying capabilities to be developed.

The above rationale suggests the need to identify the relevant metrics of capabilities that are consistent with the strategic goals being pursued, and that a significant relationship between “capability sets” and “goal-setting capability” exists if sufficient attention is given by managers or practitioners in the ways of relating their development with their choice of safety management strategy. Given this assumption, the derivation of my first hypothesis is:

**Proposition H1:** There is a positive and significant association between safety management capabilities and goal-setting capability.

**Critical capabilities and proactiveness**

When considering management capability, it is desirable to incorporate a breadth of success aspects. As such, capability includes management issues of efficiency and effectiveness, as well as organizational issues of control, communication, and organizational knowledge (see also Jiang, Muhanna & Klein, 2000; Jones & Harrison, 1996; Nidumolu, 1995). The organizational issues involve the knowledge gained by the organization during development, the interpersonal
relations maintained, and the ability to control and develop the resources. All these issues are affected by the capability and degree of proactiveness that stakeholders are trying to develop.

Consistent with the above studies about capability approach, the argument here is that the choice of positioning in terms of proactiveness is strategically determined: higher levels of proactiveness are associated with greater emphasis on development of capability. In contrast, the emphasis of reactive approach is on *ad hoc* basis rather than strategic choice adaptive to long term development needs. As pointed out by Govindarajan and Shank (1992), managers control their own actions, but they cannot control the states of nature (or “being”) that combine with their actions to produce desired outcomes.

Following the above rationale, it can be argued that there is a greater need for increased proactiveness in managing workplace safety. This need for enhanced proactiveness may be satisfied with greater attention to capability development as a long term solution to safety management issues with a contingency framework that promotes safety management as a strategic issue. These arguments form the basis of my second hypothesis:

**Proposition H2:** *There is a positive and significant association between pro-activeness and critical safety management capabilities.*

### 6.9 Chapter summary and discussion

The notion of strategic capability development is introduced in this chapter as one of the major concepts to seek adequate possibilities for managing safety at work. The framework derived from Sen’s approach is a contingency model based on a radical concept that takes into account the present state of well-being and the highly variable degree of future uncertainties. It is an integrative paradigm driving a research strategy, in which the phenomenon observed will be based on the action and self-efficacy of practitioners. Such an integrative paradigm is contingent on changes. It involves a system approach consisting of a collection of essential parts or critical elements, processes or activities (strategic and/or operational) unified to accomplish an overall goal. In reality, the action so required is a kind of natural response to goals and objectives involving both strategic and operational activities, but it should be understood that the effectiveness of which is often influenced by a variety of social and personal factors.

Conceived by Amartya Sen, the capability approach has provided the intellectual foundation for human development, functioning and well-being as central features of human development. Drawing on his philosophy, the Strategic Capability Development approach advocated in the present study is an attempt to reconstruct the safety management foundation aiming to expand people’s capabilities with a core set of things that adds value to what we are
currently capable of doing in dealing with risks and uncertainties related to workplace safety. This capability development framework has provided two basic functions: (1) to integrate and organize ideas from research into parsimonious concept and principles; and (2) to guide the design and interpretation of research (as illustrated in the next two chapters). The goal of conceptual analysis is to elucidate some of the philosophically important concepts that we can use in practice.

Even though Amartya Sen’s capability approach, in particular its evaluative aspect, has some criticisms, I believe it rests on a firm philosophical foundation. Also, while there are some aspects of the SCD conceptual model that are not new as compared with Sen’s approach, some aspects are. Basically, what Sen has been advocating is freedom of development, but the central claim of SCD is founded on strategic development. If we look at the SCD approach presented in this thesis, we can see that learning, capability building, and organizational growth are interdependent. The developmental challenge is to understand the interdependence of the process elements and act to develop each appropriately while keeping the whole in mind.

Growth and capability development are never ending. The cyclic nature of the SCD approach implicates that even a fully developed mature organization will unavoidably encounter turbulent times in its course of development. Once individuals reach a certain level of competence and social awareness, the organization will need to re-clarify its fundamental vision, values, and goals to deal with the new challenges ahead. The SCD concept, I therefore maintain, plays a central role in guiding how we maximize our efforts to ensure sustainable development. So by uncovering the relevant theories and concepts we can elucidate philosophically important concepts, like the concepts of criticality, conditionality, contingency theory, strategic choice and reflective practice in this case of capability development.

The essence of the proposed model centres on a dynamic synergy creation process characterized by a delicate management of the relationships between safety goals, human resources, capability set, functioning and state of well-being, which jointly provides an answer to the main research question. The importance and the roles of goal-setting capability and proactiveness have been discussed. Two hypotheses of mutual dependency have been developed to postulate the general relationships between these ingredients and clusters of capabilities. These hypotheses have been developed based on my argument about the reciprocity and mutual dependency between critical capabilities (see Chapter 5). In addition, the propositions are implicitly postulated by:

1. the ways of relating things as implicated by the and coherent reciprocity principle (see also Chapter 5);
the fact that the choice of positioning in terms of proactiveness is strategically determined, and

the assumption that the process elements of SCD are connected and dependent on each other.

Given these arguments, assumptions and propositions, the next chapter will show how a “Safety Management Efficacy Scale” (SMES) is constructed for assessing the efficacy of safety practitioners, and how the instrument and survey method are designed for testing the hypotheses. It can be seen that the work reported in the next chapter will focus on examining the efficacy of individual safety practitioners. In the end, the outcome would be an interpretive or explanatory investigation of practitioners constructing themselves to deal with safety issues in their businesses.
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Chapter 7: Assessing safety management efficacy – methodological issues

7.1 Introduction

In the previous chapter, “Strategic Capability Development” (SCD) is seen as a strategy to provide long term solutions for achieving appropriate safety functioning and for maintaining workplace safety well-being. This was drawn on Sen’s (1993) philosophy which is strongly based on capability, functioning and well-being. However, central to the operationalization of the SCD model is how capability is to be evaluated since “what gets measured and rewarded gets done” (Petersen, 1996).

The selection of method for my empirical study in dealing with the evaluative aspect of SCD has deviated from Sen’s research tradition. Instead, I have taken a social cognitive perspective based on an argument that human capabilities provide humans with cognitive means by which to determine their actions and behavior. This argument is in line with Albert Bandura’s Social Cognitive Theory that most external influences affect behavior through cognitive processes (Bandura, 1989). The same argument is also consistent with Sen’s belief in social conversion factors at play in the process of transformation and capability acquisition (see Sen, 1985, “Commodities and Capabilities”, and my discussion in the previous chapters).

This chapter focuses on some of the issues related to the evaluative aspect of the approach. It also explains why self-efficacy theory is used to formulate the research design. The purpose is to help readers understand the methodological choice for assessing capability maturity.

At the end of this chapter, a Capability Maturity Model is also devised to provide a roadmap for transforming an organization and its level of proactiveness by steadily improving its capability and safety practices.

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63 See Chapter 6, Section 3, for more about “operationalization”.
64 Albert Bandura, professor of psychology, Stanford University, is recognized as the “father” of self-efficacy theory [Bandura 1986, 1997]. Bandura defines perceived self-efficacy as “beliefs in one’s capabilities to organize and execute the courses of actions required to produce given attainments [Bandura 1997],” or “to attain designated types of performances [Bandura 1986].”
Evaluative aspect of the empirical study

Up to this point, I have attempted to confer the transformative power of capability development by operationalizing the SCD approach and to highlight what critical capabilities that need to be developed. I have also attempted to explain how capabilities can be strategized through SCD for sustainable development. Yet we must also be wary of simple analogies between “capacity” and “capability” as illustrated by the “Water Dam” metaphor. By thinking of the dam as a metaphor, what we need is to build capability (the ways of getting adequate water at the appropriate time) in addition to capacity, especially in the case of safety management.

In questions of capability building and development, besides what has been discussed, it is very difficult to know a priori just how acquired capability can be put into effective use. The devil is in the details and the individuals because it is people themselves to be empowered to shape their well-being and safety functionings.

To operationalize capability approach, Sen considers the individual as the only unit that counts when evaluating well-being states. At individual level, we can evaluate and examine the relationships between some of the key variables identified in the previous chapter. That is: (1) critical capabilities, and (2) proactiveness. In other words, there are two points here: the capabilities acquired and the capabilities in use as reflected by the level of proactiveness. With this particular selection, two hypotheses have been developed (see Chapter 6, Section 8) to depict the relationships between capabilities and proactiveness. These hypotheses are:

Hypothesis H1: There is a positive and significant association between safety management capabilities and goal-setting capability.

Hypothesis H2: There is a positive and significant association between pro-activeness and critical safety management capabilities.

To test these hypotheses, a survey was designed based on the assumption that self-beliefs and capability outcomes are very much related and that self-beliefs predicates some form of strategic positioning (e.g. proactive or reactive approach). These assumed correlations, if they so exist, reflect the more situational perspective of efficacy theory. Therefore, in examining these hypotheses, my empirical assumption (and central belief) is that:

Understanding the self-efficacy of safety practitioners and their discursive actions may better enable capabilities to be developed that truly deal with safety issues.

See Chapter 4, Section 9, Meta-analysis of literature: identification of critical capabilities

See Chapter 4, Section 3, about the metaphor of “Water Dam”.

See Chapter 6, Section 7: Three basic dimensions of assessing effectiveness of SMS.
On this account, a basic understanding of social cognition and self-efficacy theory is deemed to be necessary.

7.2 Social cognition in development

In the process of capability development, the conversion factors are taken as the determinants that convert human resources into functionings (Sen, 1985) but influenced by a collection of social factors (see Chapter 6). In other words, capability development involves social learning, responsiveness and adaptiveness. Donald Schön in a study of social learning also concluded that “Every alleged example of local implementation of central policy, if it results in significant social transformation, is in fact a process of local social discovery.” (Schön, 1971: 161)

The contrasting “standard view” (of safety management or audit), however, sees a central belief of following a set of rules or codes of practice for managing and assessing safety effectiveness without taking into account conditionalities arising from (or implicated) by the social learning factors. Rather than encouraging “risk owners” (i.e. employees or people at work) to develop their ability, the process of discharging legal safety responsibilities undermines both the incentives to acquire those capabilities and employees’ confidence in their ability to use them. Rather than involving wider employee participation in the process of managing occupational risk, safety staff often unconsciously confuse their jobs with their “identity” (e.g. as a safety manager or safety officer). Sometimes, this confusion is caused by conditionalities explicated by law and regulations. For example, under a certain condition, an organization or company has to appoint a safety officer. Safety personnel, therefore, automatically assumes they are the only one who should take charge. Because of this confusion, learning disability among staff and workers is developed. This disability creates resistance to change and improvement. This confusion also limits interaction because it creates little sense of responsibility. It is a kind of “I am my position” syndrome described by Peter Senge (1990).

Proactive social learning and development for effective change cannot be externally imposed. Changes imposed from the outside world are likely to engender resistance and barriers. The “standard view” of managing the safety without really paying attention to capability development leads to an impairment of the self-efficacy of the employees. The traditional mode of safety management leads to very little learning at the operation level of an organization. Indeed, relying on a few (e.g. those designated safety personnel) to impose change is not a sustainable strategy because of the difficulties in closing the capability gap. To impose a model without a self-directed local learning process would bypass the active learning capability of people and promote a state of passivity. The implication is that employees are unable to take charge of their own learning process. They might get into a situation of passive learning when
obligations are externally imposed. They need to be told or to be shown (e.g. what safety rules to be observed). The forms of safety measures are masked as “risk control”. But, these ways in which the standard methodology “shows them the way” only reinforces people’s passivity and lack of self-efficacy.

The above discussion about social learning leads to some other questions about efficacy and its relation with capability assessment. For example, how do we measure safety management efficacy? And, what’s the relationship between self-efficacy and capability maturity?

Self-efficacy defined

People pursuing their career spend most of their time, learning, practicing and using their skill and knowledge. Their feelings of confidence and self-belief about their ability to learn or perform a task play an important role in promoting and sustaining their strategies in practice, which may therefore become a fundamental factor influencing the success of their strategy to achieve a certain goal (Cantwell et al., 2000; Hallam, 2002; McCormick & McPherson, 2003). And, according to Bandura (1986), the goal may be determined by the individual, task conditions, or environment, but the important point is that judgments of efficacy are in reference to performance or state of well-being.

Given some initial understanding of the role of self-belief, now let us switch our lens to self-efficacy theory. The Social Cognitive Theory (SCT) has it origin from the Social Learning Theory (SLT), which has a rich history dating back to the late 1800’s. Albert Bandura’s work on SLT began in the early 60’s. In 1986, his book, “Social Foundations of Thought and Action: A Social Cognitive Theory”, laid the foundation.

Bandura’s self-efficacy theory in SCT suggests that belief in one’s own ability to perform has a positive effect on actual performance. This theory is in general agreement with a number of motivational theories commonly recognized in the discipline of management. Some research, such as Gist (1987), finds that Bandura’s self-efficacy positively correlates with performance; belief in one’s own ability to perform actually improves performance. On the one hand, research has focused on organizational outcomes of employee self-efficacy, for example, performance issues (Sadri & Robertson, 1993; Stajkovic & Luthans, 1998), commitment (Bozeman, et al., 2001; Tracey, et al., 2001), and role of self-efficacy beliefs in student engagement and learning (Linnenbrink, 2003). On the other hand, antecedents of self-efficacy, for example, behavior (Eden & Kinnar, 1991; Eden & Zuk, 1995; Natanovich & Eden 2001) and strategies and self-efficacy beliefs in individual practice (Nielsen, 2004) were also examined.

Self-efficacy is defined as “people’s judgment of their capabilities to organize and execute the courses of action required to attain designated types of performances” (Bandura,
1986: 391). Basically, it concerns the answer to the question, “Can I do this task in this situation?” According to this definition, self-efficacy beliefs or efficacious perceptions represent a specific and situational perceived competence in terms of behavioral actions or cognitive skills that are necessary for competent performance (Bong & Skaalvik, 2003). Self-efficacy beliefs involve some judgment that the individual can or cannot do certain types of activity. Self-efficacy beliefs refer to much more specific and situational judgment of capability.

At issue of the self-efficacy concept, Bandura argues strongly that among the mechanisms of human agency (organization or activity), *none is more central or pervasive than people’s beliefs in their efficacy to manage their own functioning and to exercise control over events that affect their lives* (Bandura, 1997, 2001). A sense of personal efficacy is the foundation of human agency. And efficacy beliefs or efficacious perceptions are particularly influential determinants of human functioning. Whatever other factors serve as guides and motivators, they are rooted in the core belief that one has the power to produce desired effects by one’s actions, otherwise one has little incentive to act or to persevere in the face of difficulties. In a way, Bandura touches on a very fundamental issue of human belief which is beyond Sen’s focus of attention. But inevitably belief, capability, and functioning are closely related. These psychological processes, involving self-reflection and self-regulation, are what give people the capability to contribute proactively to their development (Bandura, 1977, 1997).

Capability development, however, is not just a matter of simply acquiring knowledge and skills. It is a matter of being open to outside world in a way that reaffirms one’s autonomy in the learning and development processes. For Gandhi, this autonomy is self-actualization. This is *swaraj*, a form of self-rule or a state of independency:

> “I do not want my house to be walled in on all sides and my windows to be stuffed. I want the cultures of all lands to be blown about my house as freely as possible. But I refuse to be blown off my feet.” (Gandhi, quoted in Datta 1961: 120)

Gandhi teaches us that, from an intellectual standpoint, only by remaining “on one’s feet” can we have the self-confidence and ability to select, assimilate and adapt learning in a social context instead of being rendered ourselves dependent on other people to tell us what to do. People who achieve success are those who engage in planning, identifying specific goals, and designing strategies to work toward them (Peters & Waterman, 1982). On the contrary, if people at work lack self-confidence about the efficacy of their actions and directions, they might lack self-confidence in their own capability as well. In an extreme state of dependency, like a string-puppet, they might not only be passive in their actions but also in their attitude. This cognitive

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68 According to Amartya Sen, a person’s capability set represents her freedom to achieve well-being and agency – and this is the dimension which Sen proposes as the informational basis for assessments of inequality, poverty, justice, and development. (Robeyns, 2004)
aspect of dependence is clearly highly relevant to understanding the detrimental effects of learning disabilities (Senge, 1990) in the context of social learning.

In a wider context, much evidence indicates that human capability develops through interactions between persons and the social contexts in which they live. They actively interpret events, evoke reactions and responses from others, and select the appropriate environments they encounter (Bandura, 1986). Within the conceptual framework of social-cognitive theory (Bandura, 1986, 1999), human functioning is understood by reference to basic cognitive systems that develop through experiences (Cervone & Shoda, 1999). In fact, the theory suggests that self-beliefs and capability outcomes are very much related. But, they also imply that development entails some form of independency.

7.3 Assessing safety management efficacy

Perception surveys

As can be seen from the work of Geller (2004) and many other researchers, measures of safety system effectiveness are often conducted in the form of perception surveys. We have also used perception surveys in non-safety applications for almost four decades, for example, the pioneering work of Dr. Rensis Likert (1967). In his organizational study, he developed a perception survey, consisting of ten key areas, for measuring employee perception related to the organization’s climate.

In 1979, a major longitudinal study of the Association of American Railroads (AAR) challenged the worthiness of traditional safety assessment methods (i.e. audit) but at the same time confirmed the value and effectiveness of perception surveys (Bailey, 1980). The Association’s investigation was to determine the essential safety elements and their correlation with safety success. The examination was conducted independently by the National Space Technology Laboratory (NSTL) with the analysis by the Computer Science Corporation. In this study 12 elements are initially identified as essential:

1. Active reporting and analysis
2. Corrective actions
3. Equipment and facilities resources
4. Hazard control technology
5. Monetary resources
6. Motivational procedures

The NSTL’s hypothesis is that high scores in these areas would correlate generally with lower accident and injury rates. However, unexpectedly, they find accident figures had little correlation with these factors. Surprisingly, their report of findings states that:

“It was an unexpected result of this study that so little correlation was found to exit between actual safety performance and safety survey scores. The overall survey score has almost no correlation with accident rates and cost indicators and is somewhat counterindicative with respect to personal injury rates. The only two categories which correlated consistently and properly with accident rates were monetary resources and hazard control technology. Two categories – equipment and facilities resources and reviews, audits and inspections – had counterintuitive correlations.” (Bailey, 1980).

This conclusion coincides with the findings of a different AAR study, which finds that responses to most pilot survey questions based on the presence or the absence of these 12 criteria does not indicate any significant differences between the organizations studied. Taken together, the conclusions seem to suggest that the effectiveness of safety programs cannot be measured by the more traditional criteria popularly thought to be factors in successful programs. In effect, this major research study, which took almost ten years to complete clearly indicates that the traditional audit was, to a certain extent, an invalid means for assessing safety success. The results seemed to be saying that a better measure of safety program effectiveness is the response for people to questions about the quality and capability of the people and management systems that have an effect on human behavior relating to safety.

Can audit be an effective metric?

Similar studies have been made since the early 70s aiming to correlate audit results with accident statistics. Most of the results suggest a low or no correlation. In a recent study of audits at Tulane University, the characteristics of nine safety management models, or audit protocols, were examined (Petersen, 2001). Each was quite different. For example, the American Industrial Hygiene Association (AIHA) suggested five basic components for a safety system, the British Standards Institute (BSI) had two basic elements, the Department of Energy five, the American Chemistry Council six, Det Norske Verita (DNV) three, the Hospital Association two, and Australian Work two. There were others not covered in Tulane Study. For instance, the British Safety Council had 30 elements, while the NOSA system from South Africa had five. The
International Control Institute system had 17 to 20 (ibid). And Hong Kong, according to the current safety management regulation and codes of practice, has 14.

According to this summary, one can see that the characteristics of safety management models, or audit protocols, are not consistent with any safety standard. Thus “in light of today’s management thinking and research, the audit concept has become suspect,” writes Peterson (2001). However, he concludes that “the audit can be an effective metric once an organization is sure that the audit elements will lead to real results.” In other words, the key to success is ensuring that auditors, safety practitioners and managers understand the safety objectives and performance standards. This entails specialized knowledge, skills, experience and capability, especially in making strategic choices. Conversely, the absence of clear goals and lack of understanding of the key safety determinants are the most common reasons safety management systems or audits fail to improve safety.

In making strategic or critical choices, the process could be rationally divided into four steps – identify options, evaluate the options against preferred criteria (e.g. safety performance standards, or critical safety determinants), select the ‘best’ option, and then take action (Allison, 1971; Hart, 1992). This rational approach suggests that identifying and choosing options can be done analytically (Li & Deng, 1999). Analysis (e.g. risk assessment) has an important role in making strategic choices but judgment and capability are also critical. In practice, it may be difficult to identify all possible options with equal clarity. It is necessary to remember that the future may evolve differently from any of the options because unexpected events can create new threats or opportunities. In order to cope with changing situations, the learning or capability development approach to strategic making enables continual learning, interaction and adaptation (Fiol & Lyles, 1985; Ansoff, 1987, Farjoun & Lai, 1997).

Determinants of safety performance

The determinants of performance represent the factors directly responsible for individual differences in compliance and participation (Bandura, 1977, 1997). Bandura argues that there are only three determinants of individual difference in performance: knowledge, skill, and motivation that affect compliance and participation. However, some authors have criticized this assumption, arguing that there may be other determinants of performance. Hesketh & Neal (1999), for example, argue that situational factors can sometimes produce individual differences in performance. But, most available evidence does suggest that knowledge, skill and motivation are important determinants of individual differences in performance across a wide range of contexts.
The determinants of safety performance and how these are to be assessed have continued to be a hot topic of unsettled debate (see Chapter 3, ‘Literature Review’ - How do we shape our safety destiny – a safety management discourse). The approaches of study vary considerably but little has been done to examine the issue using a capability approach. Many studies were taking with a retrospective approach strongly base on “observable facts”, such as accident and injury statistics, system or process elements, individual safety or risk factors and their causal relationship with negative performance indicators, but primarily most of them were concerned with answering the questions of “Where are we now?” or “What happened in the past?”. Little has been done in study of safety management to explore a method with predictive power.

It can be argued that the studies of safety culture or safety climate could be the ones that might help. However, a lot has to be done before such methods become an effective means because there is some doubt of whether "culture can be ‘measured’ at all using quantitative methodologies such as questionnaires or surveys" (Pidgeon, 1998: 204), or as the only measurement tool (Cooper, 2000). There is still some doubt about whether there is such a thing as a ‘safety culture’, or whether it might not be better to talk about ‘cultural influences on safety …’ Hale (2000).

Given all these research traditions, criticism and reservations, an understanding of the link between capability and self-beliefs would seem to be a useful addition. To enable efficacious perceptions of management capability to be assessed, an alternate means that I consider appropriate is Bandura’s self-efficacy scale (Bandura, 1986) founded upon a strong social cognition research tradition with acknowledged predictive power. The reasons for this proposition are given in the following section.

### 7.4 Self-efficacy and capability assessment

As introduced in Section 7.1, ‘self-efficacy’ functions as a mediator of performance because the construct of self-efficacy refers to belief of capability with respect to a specific behaviour. These perceptions of self-efficacy influence individuals’ (a) actual performance (Locke, et al., 1984; Schunk, 1981), (b) emotions (Bandura, et. al, 1977; Stumpf, et al, 1987), (c) choices of behavior (Beitz & Hackett, 1981), and (d) amount of effort and perseverance expended on an activity (Brown & Inouye, 1978).

#### Role of self-efficacy beliefs

Self-efficacy beliefs regulate human functioning through cognitive, motivational, affective, and decisional processes. Self-efficacy or efficacious perceptions are domain-linked self-appraisals that operate as part of a dynamic self-evaluation system that underlies individual unity and
‘belief-performance’ coherence (Bandura, 1999). They affect whether individuals think in self-enhancing ways (2002), how well they motivate themselves in the face of difficulties (1994), resiliency to adversity (1997), and the choices they make at important decisions. Through these diverse means, belief in one’s capability transcends some measure of self-control that promotes resilience and performance.


The self-efficacy construct

Of course, the improvement of performance is hardly the sole interest of psychologists; it is certainly the interest of management theorists as well. Bandura’s basic premise appears to compliment a number of other models of motivation or capability assessment generally accepted in management theory. In the early 60’s, Vroom’s expectancy theory advocates that an individual’s motivation toward performance is requisite upon their perception of the likelihood that effort will lead to adequate performance (Vroom, 1964). There are, of course, lines of research that generally support these models. In similar fashion, the more refined Porter-Lawler’s expectancy model also views the perception of the probability of effort resulting in reward as an effect on actual effort (Porter & Lawler, 1968). Further, “difficulty” is found to be one of the five significant factors within the goal-setting theory framework; specifically, goals perceived as too difficult discourage, and so are avoided by individuals (Hollenbeck et al. 1989).

Self-efficacy, performance and capability assessment

In a meta-analysis, Judge and Bono (2001) found that job performance and self-efficacy were positively related ($r=.23$). In addition, commitment has been shown to be influenced by self-efficacy (Bozeman et al., 2001; Tracey et al., 2001). It is clear from these studies that we can assume there is a positive relationship between self-efficacy and performance. A simple two-link value train: development creating capability, and capability creating performance, however, allows for some likely uncertainties and complexities (Burgoyne, Hirsh & Williams, 2004), for example:
Management capability may come in many forms and be measured in different ways.

There may be many different processes by which forms of capability contribute to forms of performance.

There may be many different development processes that develop different forms of capability.

How these processes work may vary with context (e.g. size, industry sector, type of organization, etc.)

In addition to postulating the mechanism by which behavioural change occurs, Bandura (1977) invented his own terminology for internal interactions, the reciprocal determinism of his cognitive learning theory. He also places great emphasis on the complexity of such multiple relationships. His concepts of reciprocal determinism, observational learning, self-regulation, and self-efficacy have been used by theorists to contribute to our understanding of various human resource development constructs.

Perhaps the most compelling argument for using Social Cognitive Theory to inform human resource development theory is the proliferation of recent theory-based articles that incorporate various components of Bandura’s theory since the inception of the Academy of Human Resource Development’s theory-building journal, Human Resource Development Review (first issue, March 2002). In particular, Bandura’s concept of self-efficacy appears to be of great determining factors that influence both learning and performance (Swanson & Holton, 2001). Lim and Chan (2003) also conclude in their work to support the others that self-efficacy is one of the factors that is positively related to motivation for skills upgrading. They note that “presumably, self-efficacy affects an individual choice of activity and the act of choosing may in turn raise his/her level of motivation” (Lim & Chan, 2003: 222).

### 7.5 Measurement problems in the application of the self-efficacy construct

Bandura (1997) suggests that the adequacy of a self-efficacy measure can be assessed in terms of construct validity, specificity and range of task demands. The measure should demonstrate that it can measure what it claims to measure. To this end the measure should be able to demonstrate that it can predict the “…effects specified by the social cognitive theory in which the efficacy factor is embedded.” (Bandura, 1997:45).

Methodologically, in considering the measurement of efficacy, the researcher must consider that there are different levels of task demand in any domain of investigation (Pajares, 1997). Despite the wide application of self-efficacy theory, both Bandura (1997) and Pajares (1997) have highlighted significant conceptual measurement problems in the application of the...
construct. In order to adequately conceptualize self-efficacy measurement in the social domain it is important to first consider that self-efficacy beliefs are thought to vary across three dimensions, namely, level, strength, generality and specificity (Pajares, 1997).

**Levels of demand**

Self-efficacy items should attempt to assess the range of tasks in any given domain. In the domain to be examined, the level of difficulty may be very subjectively determined. Although some self-efficacy measures present tasks of increasing levels of demand (e.g. strategic task items of practitioners’ safety management job) it should be noted that some tasks may not be so simply stratified. Some self-efficacy scales may quite appropriately include a range of items without specifying any particular order because of the particular nature of task varies by individual (Bandura, 1997).

**Strength**

Self-efficacy beliefs also vary in strength. The greater or stronger one's belief in their efficacy may lead to greater perseverance to perform a chosen activity and perform it successfully. While weak beliefs may be easily worn away, strong beliefs may be more robust to challenges. For this reason, particular attention should be given to assessing efficacy on a scale that allows for wide differentiation of self-efficacy beliefs instead of focusing too much upon a narrow set of ill-defined tasks (Bandura, 1997).

**Generality**

A major criticism of efficacy measurement has related to the issue of generality and correspondence with the *criterial task*. Generality typically refers to a level of assessment that is closely linked to domains of activity and situational contexts. Bandura (1982, 1986) argues that judgments of capability matched to a specific outcome afford the greatest prediction and offer the best explanations of behavioural outcomes because these are the sorts of judgments that we call upon when confronted with getting things done. All this is to say that capabilities assessed or tested should be similar capabilities with the same degree of specificity. This is an especially critical issue in self-efficacy studies that attempt to establish causal relations between beliefs and outcomes (Bandura, 1982, 1986).

General rather than specific forms of self-efficacy measurement include those that seek a judgment of one's general competence without specifying what exactly is being assessed. These types of general measures imply that self-efficacy is a decontextualized judgment rather than a context-specific judgment (Pajares, 1996). In order to achieve an optimal level of self-efficacy assessment, we should ensure self-efficacy judgments are consistent with the domain of
functioning under investigation. (Pajares, 1996; Bandura, 1997). Contrasting to generality, Pajares concludes that “[the] optimal level of specificity of any efficacy assessment depends on the complexity of the performance criteria with which it is compared, and that judgments of competence need not be so microscopically operationalized that the assessment loses all sense of practical utility.” (Pajares, 1996). This is a crucial consideration, in any design of efficacy scales.

7.6 Other research considerations

There are several issues here related to the design of efficacy scales – specificity matching, correspondence, vagueness, optimum conditions, principle components, and validation criteria. Self-efficacy theory suggests that we need to separate out very general capability from specific capabilities. For example, we have to distinguish the general belief that “I’m good at math,” from more specific judgments about the different types of math tasks, or “I’m confident in managing risks at work,” from more specific self-efficacy about the specific tasks of risk management.

Specificity is an methodological issue that should be handled with care. The major criticism is that assessments of confidence that connect to self-efficacy judgments are often used instead of more appropriate specific measures. In measuring self-efficacy beliefs, researchers should attempt to predict outcomes from people’s self-efficacy beliefs with the levels of specificity and correspondence in mind. This is often ignored in efficacy research. In many studies, self-efficacy evaluations attempt to assess generalized efficacious perceptions of capability that bear very little resemblance to the specific tasks with which they are examining. The results often turn out to be somewhat ambiguous findings that offset the potential contribution of self-efficacy beliefs to the understanding of performances (Pajares, 1996). These problems of specificity and correspondence are the methodological issues that have to be addressed when conducting self-efficacy research.

Criterial tasks: specificity matching

Consistency: Generalized self-efficacy instruments basically assess "people's general belief that they can make things happen without specifying what [these things] are" (Bandura, 1997). The link between self-beliefs and behavioural outcomes is clear because evidence for construct validity comes from research supporting the postulated causes and effects. The basic problem with such assessments is that respondents usually generate these judgments without a clear set of activities or tasks in mind. As a result, they tend to provide the response by mentally aggregating perceptions that they hope will be related to what is being asked. Thus, if the purpose of a study is to achieve explanatory and predictive power, self-efficacy judgments should be consistent with and tailored to the domain of functioning and/or task under investigation (Pajares, 1996). This is
especially critical in studies that attempt to establish causal relations between beliefs and outcomes.

**Use of indices:** Meta-analysis of self-efficacy studies revealed that the effect sizes of self-efficacy on performance outcomes depend on the types of efficacy and performance measures used (Multon, et al., 1991). Effect size is a name given to a family of indices that measure the magnitude of a treatment effect (Lipsey & Wilson, 1993). The strongest effects may be obtained by researchers who compared specific efficacy beliefs, using corresponding self-efficacy or performance indices. Significant relationships can also be obtained even with generalized self-efficacy indices, a phenomenon that Multon et al. describe as reinforcing the theoretical and practical value of self-efficacy. Thus it is considered highly relevant to operationalize criterial items in a way that the indices of which become quantifiable for statistical analysis.

**Level of abstraction:** If, as Bandura (1986) argued, self-efficacy assessment should be consistent with the criterial task to be useful and predictive, what criterial task is consistent with a composite scores or ratings that comprises judgments of confidence to succeed in safety management as diverse as goal-setting, risk management, and dealing with safety issues/problems of varying difficulty? All this is to say that capabilities assessed should be the same or similar level of abstraction. These have to be consistent throughout. When these guidelines regarding *correspondence* between belief and capability are not followed, the resulting loss of predictive power is regrettably ensured.

To clarify the issue of criterial tasks selection and level of differentiation, here I try to illustrate the concept of “*generality*” and “*specificity*” by breaking down “Risk Management Capability” into a set of corresponding criteria tasks. The concept of the *differentiation, correspondence* and *specificity matching* is illustrated in Fig. 7-1.

**Fig 7-1: General vs. Specific – An example to illustrate “specificity matching”**

I believe the above to be particularly useful guidelines presented by Bandura (1986, 1997) regarding the specificity and correspondence of self-efficacy assessment. As far as the generality
of a construct to be used in organizational research is concerned, the requirement for symmetry in *level of abstraction* between predicator and criterion should also be taken into account. (Witmann, 1988; for more about “specificity match”, see Chen, Gully & Eden, 2001).

**Between vagueness and specificity**

The concept of safety management is vague and ambiguous. Since the safety paradoxes relate so centrally to uncertainty and ignorance (Ravetz, 1997, 2004; see also Chapter 2), a renewed awareness of this phenomenon can lead to positive change. In Chapter 2, I argue that risk issues have been misconceived as positivistic through a reductionist framing of the scientific problems. The development has now become something of a split within science. On the one hand are those in favour of the probabilistic approach founded on a reductionist’s paradigm, which still enjoy some success in their own right. Their methods are designed to avoid the pitfalls of accepting non-scientific evidence as real, so they emphasize specificity rather than sensitivity (70). But, in relation to problems of safety, the reductionist approach does not always work because precise data is sometimes difficult to obtain, for example, safety attitude, risk perception, self-efficacy, and the like.

Alternatively, it is the newer methodologies or practitioner-based studies (Lawrence & Murray, 2000) which are called in to solve the systemic safety problems that the traditional ones have created. In this shift of paradigm, uncertainty and ignorance are all elements of the research problem (Ravetz, 1999). The solutions to such problems are best seen as simple approximations rather as something more pragmatic, precise, or empirically robust (Nowotny et al. 2001; Jasanoff et al. 2001). As far as multidimensional measurement is concerned, issues like management capability, maturity level, and proactiveness require managing a variety of variables as well as an analysis into identifiable components and quantifiable weighting.

Bridging this dichotomy are theories of vagueness, such as Williamson’s epistemic approach (Williamson, 1994) that attempts to clarify the meaning of inexact knowledge. Well before Williamson’s theory of vagueness, Russell also argues that all natural language expressions are vague, including symbols and logical connectives (Russell, 1923: 88-89). Many postulations or propositions are vague in ordinary language without clear definitions. Their meanings are sometimes context-driven. For example, “proactive approach” or “reactive approach”, “positive culture” or “negative culture” are vague linguistic concepts in the sense that they do not have exact and universal definitions. Moreover, their connotations and meanings can change over time and they are dependent on the situations to which they are applied. For instance,

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70 Usually measured in a demanding ‘confidence limit’ on statistical tests.
the state of workplace well-being is difficult to describe because it may take on different meanings when they are used to represent safety effectiveness.

The distinction between the concepts of *vagueness* and *specificity* is not only semantically important, but also instrumentally significant in terms the choice of methods by which measurements or assessment tools is designed. To minimize vagueness and complexity, I focus on criticality to identify the critical and strategic elements or factors. The idea of which and its consistence are supported by the resource-based theory.

**Optimum conditions and principal components**

In a system design problem where one is considering various optimum conditions, component choices and system configurations, there are often *strategic goals* that need to be addressed. These can include high level objectives such as a high level of pro-activeness and adaptation for safety optimization, the goal of which is to institutionalize a robust structure for optimum performance outcomes.

By proper rating of priorities and risk classifications, for example: high, medium/moderate, or low, we can both visually understand (and sometimes quantitatively) determine which solution alternatives are clearly better than others without simplifying the objectives to only a single scalar either by a weighted sum, or weighted product. Similarly, in dealing with risks and hazards, the same approach can be applied. The ‘best’ solution for any identified issue/problem can be found in a set of effective and highly responsive solutions. The idea very similar to what I call the “Critical Capability Set” (see Section 9 of Chapter 4).

**Validation of criteria**

The final but most important issue to be considered is how the critical capabilities (i.e. the criteria) are identified and how to validate these criteria in order for them to be meaningful and effective. Considering and ensuring validity means the critical capabilities identified demonstrate what they are supposed to represent, or that they provide the value they are intended to be. Since critical capabilities are in essence constructs devised by organizations, the ideal means of validating critical capabilities would be *construct validation*. Construct validity involves ascertaining the extent to which a certain concept is crucial for and/or determines performance (Cascio, 1991; American Psychological Association, 1996), but the establishment of which involves a large amount of time as well as other resources. As Klein (1996) and Cascio (1991) point out, construct validation entails collecting information from a variety of sources and performing statistical analysis which can take years to complete.
Therefore, a more pragmatic critical capability validation approach involves content validation that relates to construct validation but do not require much in terms of resources in its own right. “Content validity is based on the extent to which a measurement reflects the specific intended domain of content.” (Carmines & Zeller, 1991: 20) Content validation can also involve sampling from a domain of information for specific performance areas and verifying that this sample is representative of the domain or population under consideration (Nunnally & Bernstein, 1994). Content validity is appropriate for critical capabilities since it involves gathering a representative sample of information which contributes to organizational success from the larger domain of performance indicators that have been established in a particular field.

Although the establishment of content validity for critical capabilities seems relatively straight-forward in the present case of my study, the process becomes more complex as it moves into the more abstract domain of perception or efficacy studies. For example, to measure self-efficacy, we must decide what constitutes a relevant domain of content for that efficacious perception. "The belief in reality is essentially the conviction that an entity transcends immediate sense data; or, to put the same point more plainly, it is the conviction that what is real but hidden has more content than what is given and obvious." (Bachelard, 1984: 31-32). In reality, safety management is obviously something to do with managing risks. The statement is transcended from our immediate sense about the relationship between safety and risk. But to cope with the need for validity we have to give evidence to justify the claim.

For the purpose of assessing capabilities at individual level, my approach in identifying the critical safety management capabilities was established by obtaining data from previous research over a period of time in the safety domain. The method is in line with the concept of “content validity” put forward by Nunnally & Bernstein (1994). This information was gathered through meta-analysis of relevant literature and then transcribed to become a validated set of critical capabilities for the purpose of this research.

A report of the meta-analysis and findings can be found in Chapter 4, Section 9, and the results in terms of a set critical capability inventory are summarized in Table 4-3. It can be seen that the findings provide us secondary data from previous experience about what we have known. It is the essential information required as explained in my proposition of SCD approach.

Given these findings of critical capabilities, what we need now is a reference frame for evaluation.
7.7 Capability Maturity Model – a reference frame for overall evaluation

To construct a reference frame, let me start by asking, “What are the characteristics of an organization that takes safety very seriously?” To answer this question, a set of high-level characteristics of safety management has to be identified in the first place. According to the SCD approach and the related discussions in the previous chapters, the characteristics can be regrouped and further summed up in four major dimensions:

1. **Appropriate goal-setting** strategy is of fundamental importance for providing proper direction, guidance and focus for the development of human resources, capability and potential in order to improve and be capable of implementing what needs to be done to reform or optimize performance outcomes.

2. **Appropriate capability development** is goal-driven, strategic and adaptable to changes in condition in order to provide long term solution to systemic safety problems.

3. **Appropriate safety functioning** in terms of risk management and control.

4. **Appropriate response** is a state of alertness in response to hazardous or risky conditions. Such a state of alertness is enhanced and maintained by developing the much needed critical capability set as suggested by the working definition that I have developed earlier in this thesis.

To compare with the above I make reference to the following list of high-level characteristics, which was first identified by Reason (1997), which has been re-communicated based on the SCD approach:

- **Goal-driven** (goal-setting) – organizational safety objectives are governed by strategic goals, which are risk-informed and highly responsive to changing workplace environment;

- **Risk-informed** (i.e. communication) – managers should know what is going on in their organization and the workforce should be willing to report their own errors and near misses without being blamed;

- **Flexible** (i.e. “risk management” or “risk-based safety management”) – organizations reflect changes in demand, and align goals and strategies to meet changing organizational and external needs. In this connection, flexibility is strongly based upon a robust risk management system, so with appropriate risk management and control organizations can
provide both high tempo and routine modes of operation and can therefore respond effectively to changes. (See “Contingency Theory” elaborated in Chapter 5)

- **Capability-oriented** (i.e. capability development) – organizations should be ready to *learn and to develop capability* of employees to reduce the probability and/or consequences of potential hazards in a specific working environment. (See “Resource-based Theory” and “Organizational Learning” in Chapter 5)

- **Self-regulated** (i.e. responsiveness) – employees are committed and provide with appropriate response to identified safety requirements or agreed procedures. This is demonstrated by a healthy state of alertness in response to hazardous or risk conditions.

Informedness follows from being informed (seeking information and learning opportunities) and reporting (providing information, making safety matters transparent). Explicitly, trust follows from being informed and transparent, knowing that even bad news can be told and accepted for what it is and responses to be acted upon. Adaptability follows from being flexible and learning to build and develop capability.

**Capability Maturity Model**

Chris Argris aptly points out that *“To intervene at a high level of competence, you must become a researcher on your own practice”* (Argyris,1980). The implication is that if we want to excel ourselves and get control of our future we must become a reflective practitioner capable of reflecting in action and improve our own doing. It is crucial for self-correcting our assumptions for on-going professional development. It is the common core of any capability approach or professional development program. For effective reflection to be possible, however, some kind of benchmark or reference is useful. A *“capability maturity model”* is therefore proposed with the following rationale.

**Reference frame for reflection**

In order to achieve the defined goals of the organization, executives need to fulfill four different roles. The roles, according to Daft and Weick (1984), are administration (caretaking role), management (efficiency), leadership (vision) and governance (stakeholders). Taking the view of Daft and Weick, we can classify safety approaches into four different types. These four types of approaches according to topographies are *inactive, reactive, proactive, and optimizing*. Organizations using an *inactive* approach try to avoid problems and wait for them to go away on their own. *Reactive* organizations approach safety by solving problems with solutions that have worked in the past. *Proactive* organizations are the ones that try to learn to become better. And
“optimizing” or “safety optimization” is the one less traveled. In practical terms, it means “safety is the way we are doing things here” with optimal effort and appropriate response to risks and hazards. It will require a new clarity to balance its fundamental safety vision against its need to act on awareness of social and ethical issues. The priority ought to be right but well served with appropriate attention, methods and service capability.

The set of characteristics highlighted above is not an easy one to acquire and I will go into more detail below on how to frame these characteristics into different levels of maturity (Fig. 7-2) as well as differentiate them into different levels of abstraction in order to understand the function of each component and its relationship with the others.

The proposed model is structured in four stages of improvement levels concerning occupational safety development. The staged structure that underlies the maturity framework was first elaborated by Crosby (1979) and then later revised by Humphrey, et al. (Humphrey, 1989) so as to install the cycle into the people development framework. For the purpose of occupational safety, the structure can be simply categorized as follows:

**Optimizing**

Safety is how we do business round here (Guldenmund 2000; Reason 2002)

**Enhanced management outcomes through enhanced capability and increasing proactiveness**

**Proactive**

We have systems in place and have the capability to manage all risks and hazards

**Aligning safety goals with changing environment through increasing informedness**

**Inactive**

Who cares as long as we are not caught

**Reactive**

We do a lot every time we have an accident

*Fig. 7-2: Levels of Capability Maturity – pathway to safety excellence*

(Source: Adapted and modified from Humphrey, 1989; Curtis, et al., 1995; Westrum, 1993, 1997; Westrum & Adamski, 1999)

The above model is based on the idea originally developed by Westrum (1993 & 1997) and Westrum & Adamski (1999) for representing a typology of organizational cultures. Here I adapt and customize it to become a 4-stage model on the progression of capability maturity (Fig. 7-2). While initially developed to explain commercial rather than non-profit organizations, I feel that the levels developed are equally applicable to other organizations or industrial undertakings. It is particularly relevant when we apply the framework to the management of safety at work.
- **Inactive**: Risk is a problem caused by workers. The main driver in matters of safety is the business and a desire not to get caught by the regular.

- **Reactive**: Organizations start to deal with risk seriously, but only after incidents/accidents is there in action. Safety is still primarily top-down, driven by management.

- **Proactive**: Safety assurance is driven by management systems, especially in managing risks, with much collection of data and evidence. With improved performance the unexpected is a challenge. Workforce involvement starts to move the initiative away from a pure top-down approach.

- **Optimizing**: There is active participation at all levels. Risk management is part of the business. Organizations are characterized by *Appropriate Safety Alertness and Response*.

The adapted “Safety Capability Maturity Model” (SCMM) is people-oriented and it is designed on the premise that improved safety practices will not automatically become effective unless an organization has the appropriate capability to deal with the planned changes. The SCMM provides a roadmap for transforming an organization and it level of proactiveness by steadily improving its capability and safety practices. The objectives of this framework are to increase the capability of workforce and organization; to ensure that capability is an attribute related to both organization and individuals; and align the motivation of individuals with the organization; and to retain human assets and critical capabilities within the organization.

Capability development is the cornerstone of the proposed model. As do all Capability Maturity Models (Humphrey, 1989; Curtis, et al., 1995; Westrum, 1993, 1997; Westrum & Adamski, 1999), the proposed SCMM consists of a number of distinctive maturity levels through which an organization's safety practices and processes are improved. It is a framework that helps organizations address capability development issues. Each stage of the framework is characterized with moving targets to be achieved, using the SCD approach. At each level, as the framework suggests, a revised set of strategic goals and a new system of practices are added to those already developed at previous stages. Each overlay of confidence, experience, objectives, procedures and practices raises the level of capability through which the organization develops further its safety practices and processes. Within this environment and well-defined management targets, people experience greater opportunity to develop their capability potential. They are therefore more motivated to align their performance with the objectives of the organization.

**Essential safety management characteristics listed in level of abstraction**

Successful safety improvement programs guided by the SCMM change the fundamental attributes of the ways of doing things —people’s capability, their practices and behaviors.
SCMM assumes that safety practices are standard organizational processes that can be improved continuously. The SCMM is constructed around strategic goals and it is based on improvement techniques that have proven effective in many organizations. The unique characteristic of the SCMM is its staged framework for steadily improving successful safety practices and people’s capability. The basic assumption is that the more mature an organization’s capability, the greater its potential for improving things. From this perspective, the staged framework of maturity is derived from the critical capability requirements in alignment with essential safety management characteristics. To achieve the desired level of safety functioning, responsible individuals perform repeatable practices as ordinary and expected requirements of their positions.

Human capability is directly related to business performance. As an organization adopts the practices and behavioural norms that satisfy the goals of the SCMM, “it establishes the shared patterns of behavior that underlie a culture of professionalism dedicated to continuous improvement” (Curtis, et al., 1995). The SCMM can be regarded as an evolutionary framework based on the concept of total quality management (TQM). Since, SCMM is developed as an organizational process by adopting the general concept of continuous improvement, improved safety practices are therefore easier to integrate with other process improvement activities. Strategically, if properly integrated with the approach of Strategic Capability Development (SCD) proposed in this thesis, the capability maturity framework will help create and maintain an enabling environment in which:

1. strategic goals are framed in alignment with the long-term capability development needs;
2. good practices can be repeated and evaluated against the established goals;
3. best practice can be transferred rapidly across groups within the organization;
4. variations in performing best practices are reduced; and
5. practices are continuously improved to enhance people’s capability in the long run.

The fundamental impediments to the model/framework are an ability to make strategic choices and an integrated approach to adoption. The SCMM framework assumes that each practice has a risk to its successful implementation because it is directly related to the maturity of the organization’s existing base of practices. Improving current practices are usually considered integral to a TQM program, if integration with other functions or processes is to be considered. However, one important premise of the SCMM model is that no sophisticated practices should be attempted until the required capabilities have been properly built (Curtis, et al., 1995).

The components of the structure of the SCMM include: goal-setting, participatory decision-making, strategic planning, motivating organizational learning, improving work practices through capability building and development. With the SCMM, and by dichotomizing safety measures and practices into the ones that are required and the ones that are not mandatory,
I can now reframe the characteristics to give a better picture in terms of “level of abstraction” as shown in Table 7-1.

**Table 7-1: Essential safety management characteristics listed in level of abstraction**

<table>
<thead>
<tr>
<th>Level of maturity</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compliance with EIO</td>
</tr>
<tr>
<td>Optimized</td>
<td>Appropriate safety functioning in terms of risk management and control.</td>
</tr>
<tr>
<td></td>
<td>Appropriate response: a general state of alertness in response to hazardous or risk conditions.</td>
</tr>
<tr>
<td>Proactive</td>
<td>Effective system in place Policy-driven strategy, but in accordance with legislative requirements. Do not directly address the question ‘How safe is safety enough?’</td>
</tr>
<tr>
<td></td>
<td>Compliance oriented: Enforcing compliance to prescriptive regulatory criteria by law</td>
</tr>
<tr>
<td></td>
<td>Capability development: meeting minimum training requirements as mandated by law</td>
</tr>
<tr>
<td></td>
<td>Focus on minimum compliance Rule-based implementation: planning, acting and controlling in accordance with rules and regulations prescribed by law</td>
</tr>
<tr>
<td>Reactive</td>
<td>Conformance to minimum requirements mandated by law</td>
</tr>
<tr>
<td>Inactive</td>
<td>Ad Hoc, not organized</td>
</tr>
</tbody>
</table>

The above characteristics define an end-point, but do not actually provide any indications about how to achieve or to assess such a safe, healthy state of ‘workplace well-being’. It will be necessary for an organization, a manager or safety practitioner to progress from its current state towards the ‘ideal’ situation. The critical issue here is whether there is an appropriate capability set to deal with the changes, and it is important for us to see the links between these parameters – goals, capability and functioning.

### 7.8 Summarizing the methodological issues

Given a brief account of what self-efficacy means in the context of capability development, the following points summarize the chapter.

First, self-efficacy is acknowledged as people’s judgment of their capabilities to organize and execute the courses of action required to attain designated types of performances. According to this definition, self-efficacy belief represents a specific and situational perceived competence
in terms of behavioral actions or cognitive skills that are necessary for competent performance. It is this belief that my SMES – Safety Management Efficacy Scale is constructed (see Appendix 4).

Second, because of the predictive and interpretative power of Bandura’s self-efficacy theory and the given criteria (discussed in this chapter), I would suggest that the ‘Inventory of Critical Capabilities’ (Table 4-3) is suitable to become a set of criterial tasks for capability assessment and for the construction of the SMES survey instrument.

Finally, I have mapped out a “Safety Capability Maturity Model” as a general reference frame for determining the levels of maturity. The model provides a roadmap for transforming an organization and its level of proactiveness by steadily improving its capability and safety practices. While application may still require some subjective judgments, the concept of the maturity model suggest that improved safety practices will not automatically become effective unless an organization has the appropriate capability to deal with the planned changes.

The next chapter reports an empirical study conducted in early 2005, using SMES to evaluate practitioners’ safety management efficacy and pro-activeness in Hong Kong.
Chapter 8: Empirical investigation of safety management efficacy and proactiveness

8.1 Introduction

“Whether you think that you can, or that you can’t, you are usually right.” - Henry Ford

How capable are you? How well do you manage safety at work? The critical capability inventory that I developed in the early part of this study draws together 30 years of research and proven techniques published by other researchers in the field of safety. The capability inventory consists of 32 items of skills and competencies that can help improve the safety managerial capability of individuals. As argued in previous chapters, the inventory can also be used to evaluate capability maturity of an individual, organization or the safety profession. The interpretative and predictive power is based on the premise that it is not simply what people believe what they are capable of doing, but how they respond to their belief, that has the greatest effect on the trajectory of their work and its outcome.

About this empirical study

The investigation was about how well the safety practitioners made use of their acquired capabilities in terms of maturity level by examining their self-efficacy beliefs and proactiveness. It focused on assessing the self-belief of safety practitioners about their ability as a measure of acquired capability.

The prime object of this empirical study was to address the capability issues that I hypothesize in my propositions (see Chapter 6, Section 8), which are restated in the next section. To achieve this aim, an intensive survey was conducted in early 2005 through which data were collected and analyzed. In this survey, alongside the Safety Management Efficacy Scale (SMES), a set of questions (using the same criteria items) was also set in order to assess, in actual practice, how often each safety task was performed by the respondents. Thus the questionnaire was designed in such a way that answering the questions would involve shuffling of responses between self-beliefs and thinking about what they were actually doing.
The main part of this chapter describes in detail the testing of the hypotheses using the SMES questionnaire, and analysis of the data collected. This involves formative evaluations, including (a) reliability estimation, (b) correlation analysis, (c) cluster analysis, and (d) collection and presentation of evidence to determine the appropriateness of the hypothesized propositions and their sub-hypotheses. These formative evaluations constitute a major effort that resulted in an excellent opportunity to obtain firsthand knowledge of the capability maturity level of the safety profession as a whole.

8.2 Hypotheses

This part of the thesis examines the hypotheses that safety management capabilities are influenced by goal-setting capability (Fig. 8-1), and that there is a significant association between proactiveness and critical safety management capabilities (Fig. 8-2). As can be seen in the Sections 8.6 and 8.7, these hypotheses are partitioned into sets of sub-hypotheses that are implicit in providing evidence support for the main ones.

Hypothesis 1: A positive and significant association between safety management capabilities and goal-setting capability exists.

Fig. 8-1a: Goal-setting capability influencing other critical capabilities
Hypothesis 2: There is a positive and significant association between proactiveness and critical safety management capabilities.

8.3 Development of the SMES

In order to test the above hypotheses I first identified those critical capabilities that need to be acquired by safety practitioners (see Chapter 4, Section 9) before looking into the use safety practitioners made of their acquired capabilities for managing safety at work in actual practice.

As far as critical safety management capabilities are concerned, the arguments seem to be much more complicated. According to the traditional views and in particular the research findings over the last three decades, I have come to a conclusion that over a hundred performance indicators are considered as crucial (Appendix 2). However, by comparing how often these items have been individually referenced in the safety literature, one can find that some activities and competencies are more important than the others (Appendix 3). The findings, summarized as a “Critical Capability Inventory” (Table 4-3), become the key indicator variables for the design of the survey instrument that I call the **Safety Management Efficacy Scale (SMES)**.

The theoretical and methodological foundation for the design of the SMES was based on Bandura’s (1986) Social Cognitive Theory (see Chapter 7). The SMES was constructed according to **three criteria**. First, the criterial items were written with specific reference to the findings of the meta-analysis that I did in 2004 (Chapter 4, Section 9). These criteria relate to the ones on top of the priority list and these priorities provide a clear indication of the critical capability sets that practitioners have to acquire. Second, the items were designed to measure perceived, rather than demonstrated, capability. Third, the SMES, comprising 32 criteria items, were worded so that the context in which respondents make their self-reflection of their safety capability could be assessed.
To summarize, several issues were of particular importance during the development of the SMES questionnaire:

1. Clearly defining the target construct and the content domain by creating a critical capability inventory, which includes validated constructs (i.e., the key assessment items that constitute the critical capability sets – see Table 4-3);
2. Ensuring the content specificity of all assessment items is consistent throughout;
3. Selecting an appropriate number of items, and writing items that are clearly worded;
4. Selecting an appropriate scale format with response options and accompanying descriptive labels; and
5. Choosing methods to assess reliability and validity (Clark & Watson, 1995; Netemeyer, Bearden, & Sharma, 2003).

Critical Capability Inventory

The items of this capability inventory are recruited as the indicator variables for the construction of the SMES, which suggest five dimensions of data should be involved. These five dimensions are:

1. Goal-setting capability (GSC)
2. Risk management capability (RMC)
3. Safety training capability (STC)
4. Risk communication capability (RCC)
5. Operation and administration capability (OAC)

Collectively, each of these five dimensions represents a set of criterial tasks. The efficacy scale for each item of assessment does not include any quantitative measuring unit. Instead, each one is represented by a scale of Likert-type. As such it cannot be used as a tool to decide the actual value of a particular modality of capability set. Rather, its value lies in eliciting the efficacious perception that decision makers, policy makers, educators and others might use to evaluate the safety management efficacy of individual safety personnel, a target group, or an organization.

Content specificity

In Chapter 7, the importance of content specificity in assessing self-efficacy was explained. To achieve item content specificity, scaled items on the SMES were aligned with critical-safety tasks of similar level of specificity without mingling with the corresponding types to which the tasks belong. As such, the resultant score provides an indication of respondents’ perceived capability for the content that the items refer at the same level of specificity.

To satisfy the criterion of content specificity, respondents were administered the questionnaire in two hypothetical contexts: one that prompted them to assess their confidence to perform the tasks and the other inquired about how often the corresponding safety tasks had been performed. Each question was not classified in the questionnaire and no attempt was made
to differentiate the type of an assessment item that it belongs. But later on the answers were
categorized and analyzed in accordance with the predetermined reference frame that classifies the
tasks into two tiers (strategic and operational) and five dimensions (see Table 4-3 for detailed
breakdown of the safety activities).

The survey instrument is composed of three distinct sections:

1. demographic data,
2. self-efficacy scales on the right-hand side of the questionnaire for measuring
   respondents’ level of confidence in respect of the questions being asked, and
3. ordinal scales on the left-hand side of the questionnaire for measuring the frequency
   of safety task performed by the respondents.

For each item of assessment, on one hand respondents were simply asked to respond to the
questions about their confidence using a 10-point Likert scale on the right hand side of the
template. A total of 32, 10-point Likert-scaled items were grouped under five distinct sets of
capability as construed by the reference frame but not explicitly indicated on the questionnaire.
This ‘unclassified’ layout of the questions was to avoid any biased attention to the questions that
might be given because of the importance of the headings that might suggest. On the other hand
respondents were also asked how often each safety task was performed. Thus, structurally, the
questionnaire was designed in such a way that answering of the questions would involve
shuffling of responses between self-beliefs and thinking about what they were actually doing.

To put the assessment items into perspective, the questionnaire was preceded by the
phrase “I feel confident…” For each item, respondents were asked to indicate their efficacious
perception from “Not at all confident” to “Very confident”, using a scale of “1-10”. Respondents
were asked to select option “1” if they did not know what the statement was about. As far as
rating is concerned, it is assumed that higher scores indicated high levels of self-efficacy. As far
as the activity survey is concerned, respondents were also asked to indicate how often they had
performed the safety tasks, using an ordinal scale to represent the task regularity (i.e. D = Daily,
W = Weekly, M = Monthly, and Y = Yearly).

8.4 Critical indicators

In the development of the SMES questionnaire, the construct consisted of strategic and
operational activities and the content domain was “capable of performing”. The instrument
contained a total of 32 items – key indicator variables – and covered two domains and five
subscales. The SMES scale construct is represented by the domain map shown in Fig. 8-2.
### Annotation of variables

SPSS (Version 13) was used throughout for the analysis of the data. Annotation was therefore created for specifying the variables and data sets which contain the observations that were needed to generate the SPSS outputs and graphical illustrations.

### CAPABILITY INDEXES

**Goal-setting Capability Index (GSC)**

**Variables -** $GSC_i$: Whether a safety practitioner is confident in her/his ability to:

| $GSC_1$ | T1: formulate and review safety policy in accordance with what is required by law |
| $GSC_2$ | T2: determine safety needs and make changes to safety goals if necessary |
| $GSC_3$ | T3: secure senior management commitment and support |
| $GSC_4$ | T4: integrate risk management into strategic decision making |
| $GSC_5$ | T5: review and evaluate safety performance |

All five variables are assumed to comprise of overall goal-setting capability index ($GSC$) which is then calculated as follows:

$$GSC = \sum_{i=1}^{5} GSC_i / 5$$  \hspace{1cm} (1)

**Risk Management Capability Index (RMC)**

**Variables -** $RMC_i$: Whether a safety practitioner is confident in her/his ability to:

| $RMC_1$ | T6: define a risk management framework and implement a process for carrying out risk assessment |
| $RMC_2$ | T7: identify hazards in the workplace |
| $RMC_3$ | T8: evaluate risks in response to hazards identified |
| $RMC_4$ | T9: set acceptable levels of risk |
| $RMC_5$ | T10: identify suitable responses to risk and implement appropriate control measures |
| $RMC_6$ | T11: review assessment of hazard and effectiveness of control methods |

All six variables are assumed to comprise of overall risk management capability index ($RMC$) which is then calculated as follows:

$$RMC = \sum_{i=1}^{6} RMC_i / 5$$  \hspace{1cm} (2)
Safety Training Capability Index (STC)

Variables - $STC_i$: Whether a safety practitioner is confident in her/his ability to:

- $STC_1$: T12: identify safety training needs of the organization
- $STC_2$: T13: plan and implement the training of staff involved in risk assessments
- $STC_3$: T14: provide in-house training in safety/risk management for management staff
- $STC_4$: T15: mainstream safety at work for employees by providing appropriate competence training
- $STC_5$: T16: review training strategy on a regular basis

All five variables are assumed to comprise of overall safety training capability index ($STC$) which is then calculated as follows:

$$STC = \frac{\sum_{i=1}^{5} STC_i}{5} \quad (3)$$

Risk Communication Capability Index (RCC)

Variables - $RCC_i$: Whether a safety practitioner is confident in her/his ability to:

- $RCC_1$: T17: establish a communication process for risk communication
- $RCC_2$: T18: communicate information about work-related hazards to all relevant parties
- $RCC_3$: T19: promulgate instructions and guidance relating to legislative requirements
- $RCC_4$: T20: organize and promulgate safety information using appropriate information systems
- $RCC_5$: T21: prepare safety manuals and propose in-house safety rules

All five variables are assumed to comprise of overall risk communication capability index ($RCC$) which is then calculated as follows:

$$RCC = \frac{\sum_{i=1}^{5} RCC_i}{5} \quad (4)$$

Operational & Administration Capability Index (OAC)

Variables - $OAC_i$: Whether a safety practitioner is confident in her/his ability to:

- $OAC_1$: T22: facilitate safety committee meetings
- $OAC_2$: T23: develop and implement safety plans
- $OAC_3$: T24: check compliance with legislative requirements
- $OAC_4$: T25: conduct routine safety inspection
- $OAC_5$: T26: conduct induction training for new employee
- $OAC_6$: T27: conduct accident investigation & incident analysis
- $OAC_7$: T28: reinforce in-house safety rules
- $OAC_8$: T29: prepare accident and incident reports
- $OAC_9$: T30: compile and analysis safety statistics
- $OAC_{10}$: T31: resolve safety problems reported by subordinates
- $OAC_{11}$: T32: establish emergency procedures for potential hazards or disastrous happenings

All eleven variables are assumed to comprise of overall operation and administration capability index (OAC) which is then calculated as follows:

$$OAC = \frac{\sum_{i=1}^{11} OAC_i}{5} \quad (5)$$
Overall Capability Index (OCI)

Variables - \( OCI \): Whether a safety practitioner is confident in her/his ability to perform all the specified tasks (T01, T02, T03, … & T32)

All 32 variables are assumed to comprise of overall capability index (OCI) which is then calculated as follows:

\[
OCI = \frac{\sum_{i=1}^{32} OAC_i}{32}
\]  

(6)

LEVELS OF PROACTIVENESS

To develop SPI, the following four variables (\( PRM_i \), \( PST_i \), \( PRC_i \), and \( POA_i \)) were selected, based on the findings of the meta-analysis (see Chapter 4, Section 9) and responses of safety personnel in their return of the questionnaire. This is to reflect the intensity level of proactiveness based on their normal practice, and to indicate the frequency of safety tasks (on the left-hand side of the questionnaire) in response to how confident they were in performing the safety tasks.

Safety Proactiveness Index (SPI)

\( SPI_i \): Regularity of the safety tasks performed, in particular those related to risk management, safety training, risk communication, operation and administration activities, is an indication of how often safety tasks are performed for ensuring workplace safety and for achieving the expected safety outcomes.

For each variable, respondents were asked to indicate how often a safety task was performed in relation to how confident they were in performing the task.

\[
SPI_i = 0, \text{ if tasks are not performed;}
SPI_i = 1, \text{ if tasks are performed annually;}
SPI_i = 2, \text{ if tasks are performed monthly;}
SPI_i = 3, \text{ if tasks are performed daily or weekly;}
SPI = \text{ median value of } X_1, X_2, X_3 \text{ and } X_4
\]

Level of Proactiveness – Risk Management

Variables - \( PRM_i \): Whether risk management tasks are performed regularly:

\[
PRM_i = 0, \text{ if tasks are not performed;}
PRM_i = 1, \text{ if tasks are performed annually;}
PRM_i = 2, \text{ if tasks are performed monthly;}
PRM_i = 3, \text{ if tasks are performed daily or weekly;}
PRM = \text{ regularity of Tasks T6, T7, T8, T9, T10 and T11 performed by the respondents, represented by the median of the respective sample data}
X_i = PRM = \text{ median value of } PRM_1 \text{ and through to } PRM_6
\]
Level of Proactiveness – Safety Training

Variables - $PST_i$: Whether safety training tasks are performed regularly:

$PST_i = 0$, if tasks are not performed;
$PST_i = 1$, if tasks are performed annually;
$PST_i = 2$, if tasks are performed monthly;
$PST_i = 3$, if tasks are performed daily or weekly;

$PST = \text{regularity of Tasks T12, T13, T14, T15 and T16 performed by the respondents, represented by the median of the respective sample data}$

$X_2 = PST = \text{median value of } PST_i \text{ and through to } PST_5$

Level of Proactiveness – Risk Communication

Variables - $PRC_i$: Whether risk communication tasks are performed regularly:

$PRC_i = 0$, if tasks are not performed;
$PRC_i = 1$, if tasks are performed annually;
$PRC_i = 2$, if tasks are performed monthly;
$PRC_i = 3$, if tasks are performed daily or weekly;

$PRC = \text{regularity of Tasks T17, T18, T19, T20 and T21 performed by the respondents, represented by the median of the respective sample data}$

$X_3 = PRC = \text{median value of } PRC_i \text{ and through to } PRC_5$

Level of Proactiveness – Operation & Administration

Variables - $POA_i$: Whether operational and administrative tasks are performed regularly:

$POA_i = 0$, if tasks are not performed;
$POA_i = 1$, if tasks are performed annually;
$POA_i = 2$, if tasks are performed monthly;
$POA_i = 3$, if tasks are performed daily or weekly;

$POA = \text{regularity of Tasks T22, T23, T24 through T32 performed by the respondents, represented by the median of the respective sample data}$

$X_4 = POA = \text{median value of } POA_i \text{ and through to } POA_{11}$
8.5 Research design

The hypotheses may be scored as competing where only one hypothesis can be true or as multiple hypotheses where each is evaluated independently. Facts become evidence when they are relevant to a hypothesis or sub-hypothesis. Of equal importance is to understand the relationship between the parameters or variables that will be used. To illustrate the relationship between the variables, a research model depicting statistical techniques has been developed (Fig. 8-3) to deal with the above hypotheses.

![Research Model](image)

**Fig. 8-3: Research Model**

8.6 Target population and sample size

The scope of study consisted of safety practitioners in Hong Kong. Safety practitioners are defined in this research as the people who are *regularly* and *directly* involved in safety matters of an organization, for example, safety managers, safety officers, safety supervisors, safety auditors and consultants, and other safety capacities (e.g. safety coordinator, safety department head, etc). The definition given in this study also includes registered safety practitioners and/or members of safety and health associations or professional bodies.
The sample for efficacy analysis included all safety practitioners, whose contacts were based on a combined mailing list of safety associations and professional bodies, as well as those who were past graduates of the safety programs that the author had been involved in the past few years. 570 questionnaires, representing 47.5% of the total safety workforce population of 1200, were sent. At the end of the data collection period (March – April 2005), 172 of them were returned; a responding rate of 30%. Given the length and detail of the questionnaire, this is an encouraging result. Nevertheless, about 50 percent of the total safety workforce was missed out from the survey because a comprehensive list of all contacts did not exist. Including those who did not respond, together it raises the issue of a non-response or probability bias in the current study. Such a possibility is always present in mail surveys. That is, do the results reported in this study misrepresent the true picture? Alternatively, if additional data were generated from the non-respondents, would this new information vary significantly from the information provided by those who did respond to the original mail-out?

As noted earlier, the sample population included: (1) active safety practitioners as identified in the professional groups, and (2) safety practitioners, who had completed a formal course of safety education. The assumption was that these groups of practitioners could be more responsive to those ‘passive’ practitioners. In other words, this strategy of sampling helped reduce the possibility of a non-response bias and, possibly, facilitate a high response rate. As a result, the representativeness of the response was improved; that is, the probability of non-response bias was managed. In addition, by covering almost half of the total population and by focusing on active practitioners, the effort tended to “smooth” or average the potential problem of bias probability. Improvement in this regard is evident by the fact that the 172 safety practitioners, who responded to the survey, represented 14.3% of a total workforce of 1200 safety practitioners in Hong Kong. It is also evident that the actual response rate (of 30%) was high enough to offset the potential bias quite significantly.

8.7 Sample and data collection

Score validity indicators

The SMES comprised 32 items designed to assess respondents’ safety management efficacy. As explained in Chapter 7, the survey was an evaluation of safety practitioners in relation to safety management efficacy that assesses a broad range of cognitive (e.g. goal-setting, risk management, safety training, risk communication, and operational/administrative capability).

71 Figure based on the information obtained from a Safety Officer Advisory Committee meeting, 2004. However, the unofficial figure was around 1,800.
The indicators, which are intended to reflect self-efficacy belief as a measure of capability, were computed for each task individually and then a combined index collectively. Items on the goal-setting (Capability Set No. 1) and risk management (Capability Set No. 2), for example, were answered on a 10-point Likert scale from ‘1’ (Not at all confident) to ‘10’ (Very confident). A higher score obtained in Set #1 indicates a more favorable goal setting strategy. The same applies to Set #2, which is later on operationalized as a set of Risk Management Capability (RMC) Index at the data analysis stage. In Set #2, the RMC indicates a higher level of risk management capability and a more favorable risk-based safety management style.

**Demographic data**

Respondents were simply asked to state their age, their present position in the organization, number of years they had been working as a safety practitioner and for how long they had been in their present position.

Initial scanning showed that, among these completed questionnaires, 5 of them were identified as invalid, either because they were incomplete or totally biased towards a certain extreme, for example, absolutely confident in all 32 items or entirely negative towards another extreme. By eliminating these outliers, ultimately, 167 usable responses were obtained. Amongst the 167 cases \((n = 167)\), there were:

- 25 safety managers \((15\%)\)
- 12 safety consultants/auditors \((7\%)\)
- 57 safety officers \((34\%)\)
- 33 safety supervisors \((20\%)\)
- 40 others in different capacities \((24\%)\)

*The mean of the number of years of safety experience was 5.44 years \((SD = 4.53\ years)\).*

**Administration of questionnaires**

SMES questionnaires, with a covering letter, were sent out by post with return envelops. Respondents who agreed to participate were requested that completion and return of the questionnaires would constitute informed consent and that this consent incorporated an understanding of the purpose and use of the data so collected. Responses were anonymous. It was stressed that under no circumstances the data will be disclosed to any third party and the data will be kept strictly confidential in accordance with the university’s ethical rules.

**Data processing**

The questionnaires were checked for completeness and questionnaires with incomplete or biased data discarded. The responses were captured from the questionnaire in the SPSS (Version 13) statistical software program. Some basic calculations were made to test the reliability of the data.
Data analysis

The analysis consisted of the following techniques:

1. Internal consistency reliability: for calculating of the internal reliability of each subscale to find the indicated correlations between responses.
2. Correlation Analysis: for conducting a correlation analysis to determine whether the hypotheses are supported.
3. Content Evidence of Capability Maturity and Activity Profiles: for calculating rating scores of capability indexes and frequency of activity levels by respondents’ job position.

8.8 Testing Hypothesis 1

HYPOTHESIS 1: A positive and significant association between safety management capabilities and goal-setting capability exists.

Null Hypothesis: There is no ‘interaction’ between the measured variables – GSC, RMC, STC and RCC.

Sub-hypotheses:

Hypothesis 1a: The risk management capability, operationalised as RMC Index, is positively associated with the goal-setting capability (GSC).

Hypothesis 1b: The safety training capability, operationalised as STC Index, is positively associated with the goal-setting capability (GSC).

Hypothesis 1c: The risk communication capability, operationalised as RCC Index, is positively associated with the goal-setting capability (GSC).

Hypothesis 1d: The operation and administration capability, operationalised as OAC Index, is positively associated with the goal-setting capability (GSC).

Empirical evidence

In order to test the hypotheses I first started to compute the standard measure of internal consistency.

(a) Results of reliability analysis

32 items make up the SMES. How reliable is this scale? Do all the items belong in the scale? Reliability is one of the most important characteristics of good empirical measures. Reliability analysis typically measures the internal consistency of multiple-item scales by estimating a “true” score and comparing the observed score to it. As far as establishing a target level for the size of the alpha coefficient, Clark & Watson (1995) suggest using an alpha level of at least .80
for a new scale. Thus I used Cronbach’s alpha coefficient to measure alpha level of the subscales, and I would expect to find the intended measure score higher than what Clark & Watson suggest.

“The Reliability Analysis procedure calculates a number of commonly used measures of scale reliability and also provides information about the relationships between individual items in the scale. Intraclass correlation coefficients can be used to compute inter-rater reliability estimates” (SPSS Help file). For this analysis \((n=167)\), I used the data (Data File\(^72\); SMES.sav) regarding respondents’ self-efficacy about their ability in performing the tasks detailed in the SMES questionnaire. SPSS reliability analysis (Cronbach’s coefficient alpha) shows that the reliability for the 5 self-efficacy scales that measure the respondents’ safety management efficacy is .958 (Table 8-2) and the inter-item correlation matrix, as shown in Tables 8-3 and 8-4, suggests that the inter-items are highly correlated (Level of significance = .000).

SPSS: Analysis > Scale > Reliability Analysis

<table>
<thead>
<tr>
<th>Case Processing Summary</th>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Valid</td>
</tr>
<tr>
<td>Excluded(^a)</td>
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</tr>
<tr>
<td>Total</td>
<td>167</td>
</tr>
</tbody>
</table>

\(^a\) Listwise deletion based on all variables in the procedure.

Table 8-1

<table>
<thead>
<tr>
<th>Inter-Item Correlation Matrix</th>
<th>GSC Index</th>
<th>RMC Index</th>
<th>STC Index</th>
<th>RCC Index</th>
<th>OAC Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSC Index</td>
<td>1.000</td>
<td>.380</td>
<td>.760</td>
<td>.798</td>
<td>.731</td>
</tr>
<tr>
<td>RMC Index</td>
<td>.380</td>
<td>1.000</td>
<td>.833</td>
<td>.835</td>
<td>.823</td>
</tr>
<tr>
<td>STC Index</td>
<td>.760</td>
<td>.833</td>
<td>1.000</td>
<td>.866</td>
<td>.854</td>
</tr>
<tr>
<td>RCC Index</td>
<td>.798</td>
<td>.835</td>
<td>.866</td>
<td>1.000</td>
<td>.869</td>
</tr>
<tr>
<td>OAC Index</td>
<td>.731</td>
<td>.823</td>
<td>.854</td>
<td>.869</td>
<td>1.000</td>
</tr>
</tbody>
</table>

The covariance matrix is calculated and used in the analysis.

Table 8-2

<table>
<thead>
<tr>
<th>ANOVA(^a)</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between People</td>
<td>311813.8</td>
<td>166</td>
<td>1878.396</td>
<td>12.923</td>
<td>.000</td>
</tr>
<tr>
<td>Within People</td>
<td>4175.147</td>
<td>4</td>
<td>1043.787</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual</td>
<td>53631.65</td>
<td>664</td>
<td>80.771</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>57806.79</td>
<td>668</td>
<td>86.537</td>
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<td></td>
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<tr>
<td>Grand Mean = 65.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) The covariance matrix is calculated and used in the analysis.

Table 8-3

^72 Data File: “SMES.sav” is not provided with this thesis but it is available for examination upon request.
Correlational analysis, using SPSS, also reveals that the five subscales are highly inter-related (see Table 8-3: Inter-item Correlation Matrix), and therefore the null hypothesis is rejected. It is also concluded that all subscales can be collapsed into a single construct, such as overall capability index. In addition, an internal consistency reliability (Cronbach's coefficient alpha\textsuperscript{73}) estimate of 0.984 is obtained for these 32 items (Table 8-6), which are therefore very highly inter-related. This result suggests that the scale appears to be measuring a single concept with very high internal reliability.

<table>
<thead>
<tr>
<th>Case Processing Summary</th>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases</strong></td>
<td><strong>N</strong></td>
</tr>
<tr>
<td>Valid</td>
<td>167</td>
</tr>
<tr>
<td>Excluded\textsuperscript{a}</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>167</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Listwise deletion based on all variables in the procedure.

Table 8-5

Table 8-6

(b) Correlation analysis and results

Using SPSS (Version 13) to test this Hypothesis, the 4 sets of critical capability variables (RMC, STC, RCC and OAC) is linearly correlated with GSC variables respectively. A very small numbers of outliers radically different from the majority of reported cases is depicted in scatter plots and subsequently removed. The removal of such discrepant scores is recognized as a means of producing a more reliable correlation analysis (Kinnear and Gray, 1992).

Using SPSS (Version 13) to conduct a bivariate correlation analysis, the result output is shown in Table 8-7. The second column of the table illustrates the influence of goal-setting capability on the other critical capabilities while the other columns show the correlations between other variables. In examining the results, it can be seen that there are strong associations between the variables.

\textsuperscript{73} Values of alpha of 0.70-0.80 are adequate in research studies, but above 0.80 is to be preferred.
According to Table 8-7, each group of indicator variables (GSC, RMC, STC, RCC, or OAC) is collectively important in influencing each other ($P < 0.001$). When examining the correlations between GSC and each of the other indicator variables (RMC, STC, RCC, or OAC), it can be concluded that the hypotheses are supported. Of the three indicator variables, risk management capability index, safety training capability index, risk communication index and operation/administration capability index are found to be positively and significantly related to goal-setting capability index.

Given the data above, scatter plots (Tables 8-8a, 8-8b, 8-8c and 8-8d) are prepared to represent the data according to the hypothetical relationships to be examined. By examining the graphs, the $r$-values and levels of significance, it is clear that strong positive linear correlation exists in each case. A common pattern can be observed – the data display on the graph in each case resembles a line rising from left to right. Although the scatter about the line is quite random and approximate when the corresponding values of the variables are small, a convergent pattern is clearly formed when the values increase. It is observed that all the slopes are positive, the Pearson $r$-values are ranging from .731 to .830, and the level of significance of each correlation is .000. So, statistically, the claim that, in each case, “a positive co-relation between the variables (i.e. the capability indexes) exits” is strongly supported.
SPSS 13.0 > Graphs > Scatter/Dot > Simple Scatter > Output Scatter Plot:

**Fig. 8-4a**

Pearson $r$-value = .830  
Level of significance = .000  
(2-tailed)

Legend:  
GSC = Goal-setting Capability  
RMC = Risk Management Capability

**Fig. 8-4b**

Pearson $r$-value = .760  
Level of significance = .000  
(2-tailed)

Legend:  
GSC = Goal-setting Capability  
STC = Safety Training Capability

**Fig. 8-4c**

Pearson $r$-value = .798  
Level of significance = .000  
(2-tailed)

Legend:  
GSC = Goal-setting Capability  
RCC = Risk Communication Capability
Fig. 8-4: SPSS Scatter/dot-graphs, showing correlations between goal-setting capability index and other variables

With the above tabulated results of correlation analysis and SPSS scatter/dot-graphs, an analysis was conducted with the general question concerning which capability sets are more closely related to the goal-setting capability. At the same time, evidence was examined to identify which capability set would seem to be the most critical one that the respondents had developed.

In the first instance, the magnitude of the correlation reflects the presence of a strong positive linear relationship between the various capability variables, Goal-setting Capability (GSC), Risk Management Capability (RMC), Safety Training Capability (STC), Risk Communication Capability (RCC), and Operational and Administrative Capability (OAC). As such it can be seen that they are strongly related and support each other in the development of capabilities. Given the variance within the capability indexes (for instance, GSC Index versus RMC Index, GSC Index versus STC Index, GSC Index versus RCC Index, or GSC Index versus OAC Index), the respective $r$-values, and levels of significance, a clear answer to Hypotheses 1a, 1b, 1c and 1d can be found. According the findings and analysis, it can be concluded that all the claims (H1, H1a, H1b, H1c and H1d) are justified to be valid, and that operation/administration and risk management are identified as the most critical sets of critical capabilities (OAC Index = 68.62, Significance = .000; RMC Index = 67.59, Significance = .000) that the respondents believed they were possessing (see Figure 8-8 – One-Sample Test).
8.9 Cluster analysis

In the previous step the correlations between goal-setting capability index and other key capability indexes were analyzed. Cluster analysis was used to examine associations and structure in data in order to identify empirically valid goal-setting capability and risk management clusters for testing Hypothesis 2 and its sub-hypotheses.

Cluster analysis, also called segmentation analysis or taxonomy analysis, is a multivariate statistical technique for identifying homogenous subgroups of cases in a sample population. It is usually used to group a number of observations on similarity over one or more variables, and it can be used to discover structures in data without providing an explanation (Kachigan, 1986; Hair, Anderson & Tatham, 1987). To provide empirically valid goal-setting capability and risk management clusters in this analysis, the standardised GSC and RMC values are used respectively as a clustering variable. By identifying clusters using SPSS, the characteristics that are shared, as well as those on which they differ, are determined.

In developing the research model (see Fig. 8-3), it was considered that having more than two clusters would provide a satisfactory classification although traditional high-low classification was considered acceptable. Based on the calculated standardised GSC and RMC values, the agglomerate hierarchical clustering method with complete linkage was used to identify the appropriate number of clusters.

Clusters of Goal-Setting Capability (GSC)

SPSS (Version 13) – TwoStep Cluster Analysis (74) – was used to identify the clusters. Based on the calculated GSC values, the Schwarz’s Bayesian Criterion (BIC) was utilized to identify the appropriate number of clusters. The result suggests that two clusters are seen to be the best to

---

74 The SPSS TwoStep cluster method is a scalable cluster analysis algorithm designed to handle very large data sets. It can handle both continuous and categorical variables or attributes. It requires only one data pass. It has two steps 1) pre-cluster the cases into many small clusters; 2) cluster the sub-clusters resulting from pre-cluster step into the desired number of clusters. It can also automatically select the number of clusters.
describe the sample. Number of valid cases in each cluster and final cluster centres are shown in Table 8-9. In Section 8.10, the variations in the GSC and its variables among these two clusters will be discussed.

**SPSS**: Analyze > Classify > TwoStep Cluster Analysis

Number of cases in each cluster and final cluster centres

<table>
<thead>
<tr>
<th>Cluster</th>
<th>GSC level</th>
<th>No. of valid cases</th>
<th>% of Combined</th>
<th>GSC</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High</td>
<td>98</td>
<td>58.7%</td>
<td>76.81</td>
<td>9.545</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>69</td>
<td>41.3%</td>
<td>41.62</td>
<td>15.277</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>167</td>
<td>100%</td>
<td>62.27</td>
<td>21.234</td>
</tr>
</tbody>
</table>

a GSC, goal-setting capability

Table 8-9

**Clusters of Risk Management Capability (RMC)**

Similarly, by using “TwoStep Cluster Analysis” three RMC clusters were identified to describe the sample. Number of valid cases in each RMC cluster and final cluster centres are shown in Table 8-10. In Section 8.10, the variations in the RMC and its variables among these three clusters will also be discussed.

**SPSS**: Analyze > Classify > TwoStep Cluster Analysis

Number of cases in each cluster and final cluster centres

<table>
<thead>
<tr>
<th>Cluster</th>
<th>RMC level</th>
<th>No. of valid cases</th>
<th>% of Combined</th>
<th>RMC</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High</td>
<td>75</td>
<td>44.9%</td>
<td>84.28</td>
<td>6.525</td>
</tr>
<tr>
<td>2</td>
<td>Medium</td>
<td>61</td>
<td>36.5%</td>
<td>62.53</td>
<td>6.351</td>
</tr>
<tr>
<td>3</td>
<td>Low</td>
<td>31</td>
<td>18.6%</td>
<td>37.17</td>
<td>10.543</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>167</td>
<td>100%</td>
<td>67.59</td>
<td>19.020</td>
</tr>
</tbody>
</table>

a RMC, risk management capability

Table 8-10

**8.10 Testing Hypothesis 2**

**HYPOTHESIS 2**: A positive and significant association between intensity of proactiveness and critical safety management capabilities exists.

Hypotheses:

**Hypothesis 2a**: There is a significant association between proactiveness and goal-setting capability (GSC) clusters.

**Hypothesis 2b**: There is a significant association between the intensity level of *strategy-based activities* and GSC clusters.

**Hypothesis 2c**: There is a significant association between the intensity level of *rule-based activities* among GSC clusters.
Hypothesis 2d: There is a significant association between proactiveness and risk management capability (RMC) clusters.

Hypothesis 2e: There is a significant association between the intensity level of strategy-based activities and RMC clusters.

Hypothesis 2f: There is a significant association between the intensity level of rule-based activities among RMC clusters.

Empirical Evidence

(a) Testing Hypotheses 2a, 2b and 2c

Univariate Analysis of Variance (ANOVA): To test Hypothesis 2a, 2b and 2c, the univariate analysis of variance (ANOVA) was used. The test of the hypotheses involved cluster analysis to find the clusters. As explained in Section 8.9, cluster analysis is used for making analysis in variables across or within data sets in order to find whether substantial difference exists on a set of clustering variables. Therefore, the caution of interpretation from cluster analysis is about dissimilarity clustering and having better knowledge of substantives. Using SPSS – “TwoStep cluster analysis”, a proper number of clusters can be automatically found and specified. The pre-specified GSC clusters, listed in Tables 8-9 and 8-11, are the independent variables while the five parameters ($X_1, X_2, X_3, X_4,$ and SPI) were the dependent variables.

Whereas:

Strategy-based activities (or tasks) are those variables identified as:

$X_1 = PRM_i$, Proactiveness reflected by regularity or frequency of risk management activities

$X_2 = PST_i$, Proactiveness reflected by regularity or frequency of safety training activities

Rule-based activities (or tasks) are those variables identified as:

$X_3 = PRC_i$, Proactiveness reflected by regularity or frequency of risk communication activities

$X_4 = POA_i$, Proactiveness reflected by regularity or frequency of operational/administrative activities

SPI = Safety Proactiveness Index

And to recap:

GSC Clusters Identified: (See Section 8.9 and Table 8.9)

| Cluster 1 | High Goal-setting Capability (GSC) | 98 cases |
| Cluster 2 | Low Goal-setting Capability (GSC)  | 69 cases |
Table 8-11 shows the means and standard deviations for the dependent variables in each cluster. By comparing the means of each cluster, it can be seen that the group with goal-setting capability outperforms the other cluster marginally with respect to all issues relating to intensity level of proactiveness. Using ANOVA, further analysis was undertaken to detect whether there are any significances between respondents’ intensity level of proactiveness and goal-setting capability (GSC) clusters. Tables 8-11 and 8-12 summaries the results. For levels of significance ranging from .160 to .685, it is clear that, there is no statistically significant difference among the two GSC clusters.

Table 8-11: Means and standard deviation for GSC and proactiveness index (SPI) variables in each cluster

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1</th>
<th>2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of cases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>98</td>
<td>69</td>
<td>167</td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td><strong>X₁</strong> Frequency of risk management activities</td>
<td>2.15</td>
<td>.817</td>
<td>1.96</td>
</tr>
<tr>
<td><strong>X₂</strong> Frequency of safety training activities</td>
<td>1.46</td>
<td>.676</td>
<td>1.51</td>
</tr>
<tr>
<td><strong>X₃</strong> Frequency of risk communication activities</td>
<td>1.73</td>
<td>.711</td>
<td>1.62</td>
</tr>
<tr>
<td><strong>X₄</strong> Frequency of operational/administrative activities</td>
<td>1.87</td>
<td>.603</td>
<td>1.72</td>
</tr>
<tr>
<td>SPI Overall Safety Proactiveness Index</td>
<td>1.70</td>
<td>.613</td>
<td>1.65</td>
</tr>
</tbody>
</table>

*GSC, goal-setting capability

Table 8-12: One-way analysis of variance

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Sum of square</th>
<th>df</th>
<th>Mean Square</th>
<th>F ratio</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>X₁</strong> Frequency of risk management activities</td>
<td>Between clusters</td>
<td>1.564</td>
<td>1</td>
<td>1.564</td>
<td>1.992</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>129.574</td>
<td>165</td>
<td>.785</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>131.138</td>
<td>166</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>X₂</strong> Frequency of safety training activities</td>
<td>Between clusters</td>
<td>0.094</td>
<td>1</td>
<td>.094</td>
<td>0.165</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>93.583</td>
<td>165</td>
<td>.567</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>93.677</td>
<td>166</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>X₃</strong> Frequency of risk communication activities</td>
<td>Between clusters</td>
<td>0.503</td>
<td>1</td>
<td>.503</td>
<td>0.804</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>103.305</td>
<td>165</td>
<td>.626</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>103.808</td>
<td>166</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>X₄</strong> Frequency of operational/administrative activities</td>
<td>Between clusters</td>
<td>0.825</td>
<td>1</td>
<td>.825</td>
<td>1.462</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>93.044</td>
<td>165</td>
<td>.564</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>93.868</td>
<td>166</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI Overall Safety Proactiveness Index</td>
<td>Between clusters</td>
<td>0.109</td>
<td>1</td>
<td>.109</td>
<td>.209</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>86.071</td>
<td>165</td>
<td>.522</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>86.180</td>
<td>166</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As can be seen from the above Tables, no conclusion can be drawn in regard to how sub-samples and overall index are related to the goal-setting capability.

Based on the analysis of correlations (Section 7), one can comfortably assume that goal-setting capability is particularly important for capability building. This part of my analysis, however, shows that goal-setting capability is not closely associated with how frequent a safety activity or task is performed. In other words, goal-setting capability is important but it does not influence how priority of activities is set. It can be explained that each individual or organization may have different goals to pursue, and the setting of these goals is often influenced by other factors in addition to capability of the person involved. Based on the above analysis and observations, it can therefore be concluded that the hypotheses, H2a, H2b and H2c are not supported.

(b) Testing Hypotheses 2d, 2e and 2f

Univariate Analysis of Variance (ANOVA): To test Hypothesis 2d, 2e and 2f, ANOVA was also used. Similar to the above, the test of the hypotheses also involves cluster analysis to find the clusters. Using SPSS – “TwoStep cluster analysis”, a proper number of clusters was automatically found and specified. The RMC clusters, listed in Tables 8-10 and 8-13, are the independent variables whilst the five parameters (X1, X2, X3, X4, and SPI) are the dependent variables.

Whereas:

- **Strategy-based activities** (or tasks) are those variables identified as:
  - $X_1 = PRM_i$, Proactiveness reflected by regularity or frequency of risk management activities
  - $X_2 = PST_i$, Proactiveness reflected by regularity or frequency of safety training activities

- **Rule-based activities** (or tasks) are those variables identified as:
  - $X_3 = PRC_i$, Proactiveness reflected by regularity or frequency of risk communication activities
  - $X_4 = POA_i$, Proactiveness reflected by regularity or frequency of operational/administrative activities

- SPI = Safety Proactiveness Index

And to recap:

**RMC Clusters Identified:** (See Section 8.9 and Table 8.10)

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Risk Management Capability</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>High Risk Management Capability</td>
<td>75</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>Medium Risk Management Capability</td>
<td>61</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>Low Risk Management Capability</td>
<td>31</td>
</tr>
</tbody>
</table>

Table 8-14 shows the means and standard deviations for the dependent variables in each cluster. By comparing the means of each cluster, it can be seen that the group with risk management
capability highly outperforms the other two clusters with respect to all issues relating to intensity level of proactiveness. Further analysis was undertaken with ANOVA, to detect whether there are any significances between respondents’ intensity level of proactiveness and risk management capability (RMC) clusters. Tables 8-13 and 8-14 summarize the results. For levels of significance of .000, .001 and .005, it is clear that, with the exception of variable $X_2$ concerning frequency of safety training activities, there is statistically significant difference among the three RMC clusters.

**Table 8-13:** Means and standard deviation for RMC and proactiveness index (SPI) variables in each cluster $^a$

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Management Capability (RMC)</strong></td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
<td>Total</td>
</tr>
<tr>
<td>No of cases</td>
<td>75</td>
<td>61</td>
<td>31</td>
<td>167</td>
</tr>
<tr>
<td>Mean</td>
<td>2.29</td>
<td>2.07</td>
<td>1.55</td>
<td>2.07</td>
</tr>
<tr>
<td>SD</td>
<td>.785</td>
<td>.793</td>
<td>1.091</td>
<td>.889</td>
</tr>
<tr>
<td>$X_1$ Frequency of risk management activities</td>
<td>1.48</td>
<td>1.56</td>
<td>1.32</td>
<td>1.48</td>
</tr>
<tr>
<td>$X_2$ Frequency of safety training activities</td>
<td>.644</td>
<td>.764</td>
<td>.945</td>
<td>.751</td>
</tr>
<tr>
<td>$X_3$ Frequency of risk communication activities</td>
<td>1.80</td>
<td>1.79</td>
<td>1.23</td>
<td>1.69</td>
</tr>
<tr>
<td>$X_4$ Frequency of operational/administrative activities</td>
<td>1.93</td>
<td>1.85</td>
<td>1.42</td>
<td>1.81</td>
</tr>
<tr>
<td>SPI Overall Safety Proactiveness Index</td>
<td>1.77</td>
<td>1.72</td>
<td>1.39</td>
<td>1.68</td>
</tr>
</tbody>
</table>

$^a$ RMC, risk management capability

**Table 8-14:** One-way analysis of variance

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Sum of square</th>
<th>df</th>
<th>Mean Square</th>
<th>$F$ ratio</th>
<th>Significance of $F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$ Frequency of risk management activities</td>
<td>Between clusters</td>
<td>12.176</td>
<td>2</td>
<td>6.088</td>
<td>8.393</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>118.962</td>
<td>164</td>
<td>0.718</td>
<td>1.461</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>131.138</td>
<td>166</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_2$ Frequency of safety training activities</td>
<td>Between clusters</td>
<td>1.133</td>
<td>2</td>
<td>1.004</td>
<td>1.004</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>92.543</td>
<td>164</td>
<td>0.562</td>
<td>1.004</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>93.677</td>
<td>166</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_3$ Frequency of risk communication activities</td>
<td>Between clusters</td>
<td>8.160</td>
<td>2</td>
<td>6.995</td>
<td>6.995</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>95.649</td>
<td>164</td>
<td>0.584</td>
<td>1.004</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>103.808</td>
<td>166</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_4$ Frequency of operational/administrative activities</td>
<td>Between clusters</td>
<td>5.981</td>
<td>2</td>
<td>5.580</td>
<td>5.580</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>87.887</td>
<td>164</td>
<td>0.344</td>
<td>1.004</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>93.868</td>
<td>166</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 8-14:** One-way analysis of variance

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Sum of square</th>
<th>df</th>
<th>Mean Square</th>
<th>$F$ ratio</th>
<th>Significance of $F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPI Overall Safety Proactiveness Index</td>
<td>Between clusters</td>
<td>3.416</td>
<td>2</td>
<td>3.384</td>
<td>3.384</td>
</tr>
<tr>
<td></td>
<td>Within clusters</td>
<td>82.764</td>
<td>164</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>86.180</td>
<td>166</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
By running one-way ANOVA analyses, some interesting significant peculiarities can be stated though. Risk management capability has a significantly greater influence on the activity level of risk management activities ($X_1$), which is strategy based ($F = 8.393$, *Significance of F = .000*). Other significant influences by risk management capability include risk communication and operation/administration activities for accident prevention and loss control, which are operational or rule-based (respectively, $F = 6.995$, *Significance of F = .001*; and $F = 5.580$, *Significance of F = .005*).

In contrast to goal-setting capability, it is evident management capability does have a significant influence on the overall proactiveness as illustrated by the results in examining the relationship between RMC and SPI. Analysis comparing the SPI values for each RMC level shows a highly significant difference across all three levels of the RMC ($F = 3.384$, *Significance of F = .036*).

(c) *Post hoc analysis*

A further post hoc analysis was conducted with key results tabulated in Table 8-15. The results indicate that significant differences (significant < 0.05) in $X_1$, $X_3$, $X_4$, and SPI exist between Clusters 1 (high RMC) and 3 (low RMC). However, no significant differences in $X_1$, $X_3$, $X_4$, and SPI between other clusters (1 and 2) and (1 and 3) could be detected at the same level of significance.

To pinpoint which clusters differ significantly on variables $X_1$, $X_3$, $X_4$, and SPI, a post hoc analysis using the Scheffe multiple comparison procedure was run.
Table 8-15: Scheffe

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(I) TwoStep Cluster Number</th>
<th>(J) TwoStep Cluster Number</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
<td>Upper Bound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X1 (RM)</td>
<td>1</td>
<td>2</td>
<td>.228</td>
<td>.147</td>
<td>.30</td>
<td>-1.19</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>.745*</td>
<td>.182</td>
<td>.00</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td>.228</td>
<td>.147</td>
<td>.30</td>
<td>-1.19</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>.517*</td>
<td>.188</td>
<td>.025</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td>-.745*</td>
<td>.188</td>
<td>.00</td>
<td>-1.19</td>
</tr>
<tr>
<td>X2 (ST)</td>
<td>1</td>
<td>2</td>
<td>-.077</td>
<td>.130</td>
<td>.40</td>
<td>-2.24</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>.157</td>
<td>.160</td>
<td>.619</td>
<td>-.24</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<td>1</td>
<td>-.334</td>
<td>.157</td>
<td>.106</td>
<td>-.05</td>
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</table>

* The mean difference is significant at the .05 level.

The above findings, as shown in Table 8-15, clearly demonstrate a strong association between having a low level of risk management capability and a relatively low intensity level of safety activities. On the contrary, the association is clear between having a high level of risk management capability and a relatively high proactiveness (or intensity level of safety activities) in specific areas of risk management, risk communication, operation & administration, and overall safety proactiveness index. Therefore, based on the above analysis and observations, the hypotheses, H2d, H2e and H2f, are supported.


8.11 Capability maturity profile of safety practitioners

The SMES survey aimed at assessing the capability maturity profile of the safety profession. The evaluation, using the SMES framework, has evolved into a set of findings that enables us to identify the strengths and weaknesses of the safety profession in terms of the practitioners’ overall safety management efficacy. To recap, in order to describe the capability maturity profile of the safety profession, five sets of critical capabilities are identified in Chapter 4 (Section 4.9) for this evaluation, namely:

**STRATEGIC**
- Goal-setting capability (GSC)
- Risk management capability (RMC)
- Safety training capability (STC)

**OPERATIONAL**
- Risk communication capability (RCC)
- Operational & administrative capability (OAC)

The SMES survey included safety practitioners from a wide range of organizations in Hong Kong. Among the group of respondents (n = 167) willing to participate in the survey, majority of them were either safety officers or safety supervisors:

<table>
<thead>
<tr>
<th>Role</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Managers</td>
<td>25</td>
<td>15%</td>
</tr>
<tr>
<td>Safety Consultant/Auditors</td>
<td>12</td>
<td>7%</td>
</tr>
<tr>
<td>Safety Officers</td>
<td>57</td>
<td>34%</td>
</tr>
<tr>
<td>Safety Supervisors</td>
<td>33</td>
<td>20%</td>
</tr>
<tr>
<td>Others</td>
<td>40</td>
<td>24%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>167</td>
<td>100%</td>
</tr>
</tbody>
</table>

Based on the answers to questions concerning how confident the respondents were in performing the identified safety tasks, the safety management capability maturity profiles of safety practitioners were determined. A radar chart presenting the relative capability of the compared job position is shown in Fig. 8-5. The chart illustrates the strengths and weaknesses of the sampled respondents. More importantly, an analysis of the weaknesses suggests some deficiencies are common in their safety practice.

In order not to be misleading, it should be emphasized that these profiles do not refer to their actual capability in absolute terms. Rather, the profiles make it possible for comparison and for determining their relative perception about their efficacy in managing safety in the workplace.
SPSS > compare means > means > output

Report

<table>
<thead>
<tr>
<th>Position</th>
<th>Yrs of Experience</th>
<th>GSC Index</th>
<th>RMC Index</th>
<th>STC Index</th>
<th>RCC Index</th>
<th>OAC Index</th>
<th>OCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>Mean</td>
<td>2.10</td>
<td>50.20</td>
<td>57.31</td>
<td>53.76</td>
<td>51.00</td>
<td>59.30</td>
</tr>
<tr>
<td>SC/SA</td>
<td>Mean</td>
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<td>68.67</td>
<td>71.89</td>
<td>67.00</td>
<td>66.83</td>
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</tr>
<tr>
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<td>Mean</td>
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<td>78.92</td>
<td>78.32</td>
<td>78.72</td>
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<tr>
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<td>74.56</td>
<td>78.19</td>
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<td>17.613</td>
<td>18.805</td>
<td>18.118</td>
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<td>Mean</td>
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<td>62.27</td>
<td>67.59</td>
<td>64.90</td>
<td>65.02</td>
<td>68.62</td>
</tr>
</tbody>
</table>

Table 8-16: Analysis of GSC, RMC, STC, RCC, and OAC Index by job position

Fig. 8-5: Capability Maturity Profiles of Safety Practitioners

Legend:
SM: Profile 1 - Safety Managers
SC/SA: Profile 2 - Safety Consultants / Safety Auditors
SO: Profile 3 - Safety Officers
SS: Profile 4 - Safety Supervisors
Other: Profile 5 - Other safety personnel working in other capacity

GSC: Goal-setting Capability
RMC: Risk Management Capability
STC: Safety Training Capability
RCC: Risk Communication Capability
OAC: Operational/Administrative Capability

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Interpretation and use of the results

Using the data from the SMES survey, a set of compound numbers can be determined that represent the self-efficacy scores. These scores are operationalized as capability indexes (as indicated in Table 8-16). Each of the five profiles is identified with labels that summarize the safety practitioners’ efficacy of their safety management capability in five dimensions, and respectively each profile distinguishes itself from the others according to respondents’ self-belief about the tasks they perform. In specific terms, each profile can be interpreted as follows:

Profile 1 – Safety Managers

As can be seen from the third row of Table 8-16, the mean values calculated from the SMES data suggest that self-belief of safety managers in their safety management efficacy can be described as the most confident one among the others. The profile is illustrated in Fig. 8-5. It is clear and normal that safety managers are more confident than the others, given that this group of safety practitioners was holding a management position assuming overall safety management responsibility in the workplace.

This survey revealed that safety managers had 11 years of seniority in their jobs. In general, they thus have empirical experience developed through conducting prevention activities in their organization and technical expertise stemming from their jobs. However, according to the capability indexes, their operational and administration capability (QAC) was relatively higher than the others, implying that their capability was characterized by more operational and administration ability in overall terms. Since safety managers help to influence the whole management system, there is a need for this group of practitioners to strengthen their management role by focusing more on the development of their capability in other areas, such as goal-setting, risk management, safety training and risk communication.

Profile 2 - Safety Consultants / Safety Auditors

The self-efficacy of this group of practitioners (i.e. safety consultants/auditors) described in Profile 2 is in general lower than safety managers and safety officers. The respective overall capability indexes are: Safety Consultants/Auditors, OCI_{SC/SA} = 66.95; Safety Officers, OCI_{SO} = 72.51; and Safety Managers, OCI_{SM} = 78.75. The survey revealed that safety consultants/auditors had more than 7 years of seniority in their jobs, the second highest in terms of experience among all the groups, but surprisingly their overall confidence was no better than the group of safety officers who were relatively less experienced.

Although the overall confidence of safety consultants/auditors is not as good as safety managers and safety officers, Profile 2 of this group of practitioners suggests that while a balanced attention is given to the various capability dimensions at both strategic and operational
level, risk management is one of their current strengths. Hence, it can be argued that their belief is strategic in nature although their performance might be outweighed by their overall capability.

Profile 3 – Safety Officers

The self-belief of safety officers described in Profile 3 is centred primarily on the operational dimension. The highest score is the OAC index (78.19), which suggests that more focussed attention is given to operational/administrative tasks by safety officers and they are more confident in this area when compared with the others groups of activities. This confirms Jézéquel’s hypothesis (1999) which states that safety practitioners tend to see themselves as operationalists who work primarily on the floor. As a result, they contribute less at the strategic level, though this type of management contribution should increase in the future due to the increasing importance given to the integration of prevention in management and the growing attention paid by managers to safety at work.

Profiles 4 & 5 – Safety Supervisors and the others

With relatively less experience, the profiles of these groups of practitioners are characterized by a general lack of confidence in all aspects of safety work that this safety management efficacy survey is trying to cover. In a rough way, these groups of practitioners can be classified as beginners. They are the kind of practitioner at a starting point of their career, who has some kind of preliminary knowledge and basic skills. They may be the kind of person who has just received the necessary basic training but do not have time to practise or to think about the matter in a more professional way. Although they are all beginners, they understand well the importance of risk management. This is reflected in this survey by the expression of their belief. And, statistically, their self-efficacy in this regard is higher than the confidence level of other groups of tasks.

Strengths and weaknesses

Besides capability profiles, what else do the findings suggest? An issue here is less to do with correlations between the parameters and more to do with relative strengths and weaknesses. What are the important differences between practitioners’ self-efficacy beliefs about the confidence levels of the critical capabilities?

In looking at the respondents’ strengths and weaknesses by examining and comparing the mean value of each task with the others, it is evident that there are significant variations between the scores. The results of ‘mean’ calculations using SPSS suggest that, relatively, the following are the top three activities that the respondents are most confident in doing:

1. conducting routine safety inspection (T25, overall mean = 76.05)
2. identifying hazards in the workplace (T07, overall mean = 73.71)
3. conducting induction training for new employees (T26, overall mean = 72.16)

More importantly, an analysis of the weaknesses suggests that the following deficiencies are common in the respondents’ safety practice:

4. integrating risk management into strategic decision making (T04, overall mean = 59.52)
5. formulating and reviewing safety policy in accordance with what is required by law (T01, overall mean = 60.60)
6. establishing communication process for risk communication (T17, overall mean = 60.60)

8.12 Activity profiles

A graphical way of presenting the relative activity profiles of the safety practitioners is shown in Fig. 8-11. For these profiles, the proactiveness indexes; goal-setting (PGS), risk management (PRM), safety training (PST), risk communication (PRC) and operation/administration (POA); are plotted on the five-axis radar chart. Categorically, the chart also shows the five ‘activity profiles’ of safety practitioners holding different positions. Each of the five profiles is identified with labels that summarize the frequency of their safety management activities and distinguish them from the others according to the frequency or regularity of safety tasks performed.

SPSS > compare means > means > output

<table>
<thead>
<tr>
<th>Position</th>
<th>Yrs of Experience</th>
<th>X0 (GS)</th>
<th>X1 (RM)</th>
<th>X2 (ST)</th>
<th>X3 (RC)</th>
<th>X4 (OA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
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<td>1.28</td>
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Table 8-17: Analysis of frequency of activities by job position
Activity profiles of safety practitioners

Based on the figures tabulated in Table 8-17, the Radar Chart (Fig. 8-6) shows the activity profiles of safety practitioners in respect to their positions. This survey of activity frequency and self-efficacy profile has documented that practitioners’ beliefs and their actions are of practical significance for their daily practice.

One example of the impact of this self-evaluative survey is its interpretive power to indicate how practitioners manage workplace safety. As prevailed by the findings, for instance, risk management is deemed most important to SMS and the professional groups – safety managers, safety officers and safety consultants/auditors – are the ones that are the most mature. In all the cases, regardless of the position or seniority of practitioners, it is evident that priority is given to risk management and related activities. As can be seen, the frequency of risk management activities (X₁) is the highest in comparison with the other variables (X₂, X₃ and X₄).

Statistically, by comparing Table 8-16 and Table 8-17, we will find that the results in relation to risk management are in congruence with each other. The risk management capability
index (RMC) and the frequency of risk management activities (X1) are outstandingly high among the various sets of variables. Although no particular pattern can be observed in examining the other figures, for example, GSC (goal-setting capability index) versus X0 (frequency of goal setting activities), STC (safety training capability index) versus X2 (frequency of safety training activities), and RCC (risk communication capability index) versus X3 (frequency of risk communication activities), the findings suggest that focus attention is given to operational activities. The only exception is safety consultants/auditors, whose target the specific areas of ‘risk management and risk communication’ rather than ‘risk management and operational preventive activities’. This discrepancy, however, appears to be logical as safety consultants/auditors are to a large extent detached themselves from daily safety operations while the work of the others (safety officers, safety supervisors, etc) tends to be more operational by their job nature.

Using this five-dimensional, two-tiered typology, different activity profiles of safety practitioners can be drawn. This contribution would seem to be important given that, as Hale (1999) pointed out, previous studies of safety practitioners are primarily prescriptive in nature rather than strategic or systemic.

**Key findings from activity survey**

When particular attention is given to the activity frequency in relation to the five dimensions, the following characteristics of activity profile can be observed:

1. Risk management is the top priority with the highest frequency as indicated by all activity profiles. As suggested by the figures, sufficient attention is given by all respondents.

2. Except safety consultant/auditors, all respondents regularly act on operational prevention activities, such as facilitating safety committee meetings, developing and implementing safety plans, checking compliance with legislative requirements, conducting routine safety inspections, providing induction training for new employees, performing accident investigation and incident analysis, reinforcing in-house safety rules, preparing accident and incident reports; compiling and analyzing safety statistics, resolving safety problems, and establishing emergency procedures for potential accidents or disastrous happenings.

3. The activity profile of safety officers (i.e. Profile 3) appears to be more operational in nature because, on average, the mean value of X4 (the operation/administration measure) is the highest in comparison with the others (i.e. mean value = 2.00 versus 1.88, 1.81, 1.74 and 1.45). As with the others, they are generally weak in safety training.
Comparing and contrasting the activities of safety consultants/auditors with the others, safety consultants/auditors tend to place more emphasis on risk communication rather than operational matters.

On average, by calculating the medians of activity frequencies and comparing the values, it can be seen that the activities most frequently performed by the respondents are:

- identifying hazards in the workplace [T07, median value = 3], and
- conducting routine safety inspection [T25, median value = 3].

And, in the same analysis, it was observed that the following activities were least frequently performed:

- reviewing training strategy on a regular basis (T16, median value = 1);
- preparing safety manuals and proposing in-house safety rules (T21, median value = 1); and
- developing and implementing safety plans (T23, median value = 1).

These results were in general consistent across the two sets of analysis. These profile analyses and the results add insight to the outcomes of hypothesis tests in which the five dimensions of evaluation that emerged form the correlation, ANOVA, multiple comparisons and cluster analyses are described. These profiles are marked by strong connection to respondents’ self-belief about what they are capable of doing.

8.13 Summary

Two goals guided this study. First, the study attempted to examine the hypotheses that safety management capabilities are strongly influenced by the goal-setting capability, and that there is a positive and significant association between proactiveness and critical safety management capabilities. Second, it sought to assess, in relative terms, the overall activity profiles and safety management capability of the safety profession. A series of analyses – correlation analysis, cluster analysis, ANOVA and multiple comparisons – achieved these goals. These formative evaluations constitute a major effort that resulted in an excellent opportunity to obtain firsthand knowledge of the capability maturity level of the safety profession in Hong Kong as a whole. The results are summarized and interpreted in the following sections.

Strengths of the instrument

High responding rate

The analysis presented in this chapter must be viewed with regard to sample size. It is generally accepted statistical principle that the larger a sample size the more reliable the results. Out of the
567 questionnaires, 172 of them were completed and returned by the respondents, and 167 valid cases were selected for analysis. The responding rate was 30%. The underlying structure - with *five dimensions and two tiers* – for the design of the SMES instrument was complex due to the presence of subscales. But, unlike many other efficacy scales or questionnaire, it was concise (all 32 questions on one page, including demographic data) and the style of presentation was consistent throughout. Answering of the questions was therefore not very time consuming and relatively straightforward; contributing to a high responding rate.

**Adequate sample size**

To examine research hypotheses properly, one concern in establishing desired sampling size is that there are a sufficient number of cases. Generally the literature considers 100 cases in a sample the bare minimum (Monette, Sullivan & DeJong 2002). Moreover, precision is directly related to sample size. Larger samples are more precise than the smaller ones. Therefore, the sample size of this study was considered adequate (*n* = 167) although a larger sample would be more essential for a heterogeneous population (of 1200).

**Overcoming non-response bias**

Having defined the population, it is possible to construct a so-called sampling frame, which represents a listing of active practitioners in the population. However, it is possible that biases could exist between the responses of members of the sample frame and population. Therefore, the adequacy of the sampling frame is crucial in determining the quality of the sample drawn from it. Due to the fact no complete list was available, 673 contacts was used to draw a sample, which represented about half of the safety profession. The possible shortcoming of *non-response bias* was addressed by distributing the questionnaires to practitioners at safety seminars/symposiums in a number of occasions, although some of them might have received the questionnaire by mail.

**Dependability**

*“Dependability assumes what is being studied may not be reliable, consistent, or standard.”* (O’Leary, 2004:60). The attempt to capture data of the whole population may yield much more reliable results. But, in this study, it was not possible because a full list of safety practitioners was not available. To resolve the problem of potential bias, it might be useful to ask: “Who are more representational – the active professional group members or the ‘passive practitioners’?” By considering this question of *representativeness* and *generalizability*, it was a lot easier to look for consistency within groups of active practitioners rather than a complete, 100 percent coverage.
of the whole population of 1200. By adopting this rationale, the methodological protocol was
designed in a manner that the samples included members of the following target groups:

(1) *active practitioners* as identified in the safety professional groups (e.g. members of the
Institution of Occupational Safety and Health – Hong Kong Branch, and the Society of
Registered Safety Officers), and

(2) safety practitioners, who had completed a formal course of safety education.

The assumption was that these groups of practitioners could be more responsive to those
‘passive’ ones. In other words, this strategy of sampling helped reduce the possibility of *non-
response bias* and, possibly, facilitate a high response rate. As a result, the representativeness of
the response was improved; that is, the probability of non-response bias was managed.

**Predictive power and limitations of the research instrument**

The demonstrated explanatory and predictive power of self-efficacy theory has undoubtedly
contributed to the sustained interest in this arena.

What I was trying to do was not testing Baudura’s theory. I did not deduce any specific
hypotheses from Bandura’s social cognitive theory to test. Instead, the propositions are
hypothesized based on Amartya Sen’s capability approach.

The study method was very much tied to Bandura’s theory. For example, self-beliefs in
risk management and safety training capabilities were respectively operationalized as Risk
Management Capability (RMC) index and Safety Training Capability (STC) index using a 10-
point efficacy scale. Self-efficacy scales were tailored to domains of functioning within a domain
map of two tiers and five dimensions. In this study, the internal reliability was proved to be
consistent throughout (see analysis in Section 7). Thus the obtained relations are not peculiar to
a particular assessment scale.

The schematic research model shown in Figure 8-3 serves to depict the relationships
between the variables and hypotheses that I was trying to test, and the statistical analyses were
specifically designed to test the propositions and variants that I have derived. By testing the
propositions, I was able to examine directly the relationship between self-efficacy and
proactiveness by adding a set of corresponding activity survey. This could add interpretive power
to the self-efficacy scale by examining the correlation between the efficacy scales and levels of
proactiveness. However, no attempt was made to verify the benefits of such modifications within
the scope of work I have defined. This would be testable in new studies as an extension of this
empirical work.
The fact that the findings of this study suggest that the utility of the SMES, coupled with the activity survey, provides a more reliable means for the assessment of capability maturity. Despite strong differences between efficacious perception on goal-setting capability and associated activities, there seems to be some fundamental relationship between critical capability and proactiveness. It is evident from the findings that proactiveness is strongly influenced by the critical capabilities, for example, risk management. Similarly, by comparing the capability maturity profiles (Fig. 8-5) with the activity profiles (Fig. 8-6), one can easily identify the strengths and weaknesses of individuals, groups, organizations or the profession as a whole.

**Challenges and limitations of the survey instrument**

The major challenge that the survey instrument (SMES) faces is the credibility of the method, in particular, the way in which critical capabilities are determined. Gaining acceptance of this method is a major challenge. With regard to credibility, the finding of critical capabilities from literature, using a combined approach of qualitative and quantitative research, overcomes some of the problems inherent in ‘pure’ quantitative research (e.g. questionable sampling size, representativeness and generalizability of findings). In this study, the collection and analysis of data involved statistical means (see Chapter 4, Section 4.9). However, before any statistical analysis could be done, the major effort was concerned with the extraction of information from relevant journal articles and research reports. It required detailed analysis of contents in qualitative terms. Since qualitative research is not concerned too much with generalizability to populations, it is not necessary to have the same large sample sizes that are found in survey and epidemiological research. Rather the main issue in this meta-analysis is to purposefully select relevant and information-rich literature (i.e., those publications from which we can learn a great deal about the central issues which the research addresses) (O’Leary, 2004). To support this argument, Patton (2002) makes the following statement about sample size in qualitative research:

“There are no rules for sample size in qualitative inquiry. Sample size depends on what you want to know, the purpose of the inquiry, what’s at stake, what will be useful, and what will have credibility, and what can be done with available time and resources.” (Patton, 2002: 244)

On the upfront, the important issues of sampling size (related to selection of publications) and representativeness of data are addressed in Chapter 4, Section 4.9 (under the sub-headings of “Representativeness of data”, and “Cut-off point and data saturation”). That is, the meta-analysis to identify critical capabilities was conducted in a manner that it had reached a point when little new information was gained from the data collection and analysis process.
Testing of hypotheses

In this study, Amartya Sen’s capability approach and strategic management theories provided the basis for generating hypotheses (see Chapter 6, Section 8). Sen’s capability theory and his approach implicated that variables in the study would be related in a certain way, giving rise to the need of having a set of critical capabilities based on strategic choice. This became the main construct of the assessment tool and the domain map, which one can use to assess capability within the context that I defined in the previous chapters.

The purpose of this empirical study was to collect evidence to help support the propositions and sub-hypotheses that I delineated from the theoretical framework. The importance of each type of evidence, for example, the efficacy scale and the activity survey, depends on the intended interpretations and uses of assessment results. Consider the relationship between what the respondents believed and what they actually did. For such an assessment, drawing evidence and examining their relationship would be pertinent: the extent to which proactiveness relates to capability maturity, and the extent to which capability maturity can be reflected by assessing people’s self-belief on their efficacy.

Hypothesis H1

An examination of the extent to which the capabilities identified in the SMES were elicited from the respondents. The assessment and data analysis provide validity evidence that the first hypothesis - a positive and significant association between safety management capabilities and goal-setting capability exists – is supported. This hypothesis is not a direct prediction from the social cognitive theory but rather a hypothesis inferred indirectly Amartya Sen’s theory on which his capability approach is grounded. That is, the capability development theory does not directly predict that those with different levels of capability maturity will experience different degrees of accomplishments so much as it predicts that those with different levels of capability maturity will experience different outcomes in the face of ability. Evidence can be found from the results of the hypothesis testing that, not only the main proposition is supported, between the critical capability indexes (i.e. GSC, RMC, STC, RCC and OAC) a strong correlation and mutual influence also exists.

Evidence can also be found to support the sub-hypothesis (H1a, H1b and H1c) related to the relationships between goal-setting capability and other critical capabilities. As suggested by the findings and correlation analysis (Section 7), a strong, positive association between these variables does exit. The outcome suggests that strategic capabilities, such as goal-setting, moderate the relation between critical capabilities.
**Hypothesis H2**

The testing of the second hypothesis was trying to infer that a *positive and significant association between proactiveness and critical safety management capabilities exists*. The outcome was that three hypotheses (H2a, H2b and H2c) were rejected and the other three (H2d, H2e and H2f) were supported. Based on the analysis, particularly in examining the levels of significance, no conclusion can be drawn in regard to how sub-samples of efficacy and overall index are related to the goal-setting capability. However, multiple comparisons of variables reveal that risk management is seen to be more important than the others in the way that influences the overall proactiveness. The findings in Section 9 clearly demonstrate a strong association between having a high level of risk management capability and a relatively high proactiveness. On the contrary, the association is clear between having a low level of risk management capability and a relatively low proactiveness in specific areas of risk management, risk communication, operation & administration, and overall safety proactiveness index. However in area of safety training, its association with risk management and goal-setting capability is not evident.

Clearly, however, these hypotheses are conceptually indebted to the theory of goal-setting and strategic choice, which allows people to identify their strengths and weaknesses in making strategic decisions and setting priorities for the development of future capabilities. Safety training and risk management are top of the priority list according to the findings. If risk management is a preventive safety strategy enabling organization to eliminate hazards, then safety training is a proactive strategy enabling more people in the organization to understand the role of risk and how workplace hazards can be effectively mitigated. These priorities are essential for the protection of people at work.

Central to this empirical study is the use of the SMES as a tool to evaluate and to assist in the development of capability requirement based on a set of well construed critical capabilities. Rather than trying to predict the future and build capability to meet that prediction, capability assessment is presented as a means by which, via self-evaluation, weaknesses can be identified and overcome, and strengths can be leveraged to yield maximum results. In an uncertain and volatile safety scenario, all available tools must be employed to ensure appropriate response to the changing needs. The use of the SMES is one more tool that should be experimented with to ascertain its efficacy and further usage.
Comparison of capability maturity profiles and activity profiles

The findings of this study are not indicative of the results reported in other published studies on the assessment of capabilities and proactiveness. Nevertheless, it shed some light on a number of important issues, considered prerequisites for enhancing safety in the workplace.

As its name implies, the activity survey of this study, focused its attention on the raising concerns about safety activity as well as what safety personnel made use of their capability for the protection of people in the workplace. In fact, much of the evidence collected by this survey showed that there were strengths and weaknesses associated with what safety practitioners do in their daily practice. This was not surprising. First, the great majority of practitioners, for example, safety managers and safety officers, might give special emphasis on managing risk and try to control them through various operational or administrative control measures. Second, it is employees who are most likely to be affected by workplace hazards, but it is evident that, in comparison with other safety activities, safety training effort as reflected by the frequency level was not proactive enough (see Activity Profiles as illustrated in Fig. 8-6).

Based on the analyses of capability maturity profiles and activity profiles described earlier, we might be able to generalize the current situation that safety practitioners tend to focus their work on operational activities in managing safety in their workplace. In broad terms, the respondents in the sample exhibit the following tendencies:

- **They all have a strong belief about their capability in managing risk,** and devote energy to identify hazards in the workplace and devise control measures to eliminate or reduce risk. (This is the most critical capability as far as safety management is concerned. As can be seen from the findings, safety managers and safety officers clearly feel confident in their ability to manage risk.)

- **They focus on administrative and preventives measures,** and they are good at routine operational work, in particular safety inspection, hazard identification, and induction training.

- **Strategically, they are relatively weak, especially in areas of system integration, policy setting, risk communication and formulation of safety training strategies.**

The critical capability for creating/maintaining a safe, sustainable healthy workplace comes from managing governance, removing hazards, creating a capacity for change by investing in safety training and by eliminating constraints. Risk management governance is a key component. We need to move from thinking about safety personnel (e.g. staff of the safety office) as a power or
authority to create safety value and awareness. This means safety values should be defined by the receiver (the workers and employees) and not the giver of the service (safety personnel).

Supporting the value chain of safety are capability imperatives combining strategy, technology and the organization to create capabilities in areas such as assigning accountability, promoting safety awareness and responsiveness, building management and staff commitment, ensuring continuous improvement, and leveraging and learning from good safety practices. Although these attributes were not specifically measured in this survey, the assessment of activity levels shows that safety training was bottom of the priority list in relative terms (see Table 8-17 - Analysis of frequency of activities by job position). Therefore, to bridge the gap, there is a need to invest more time and effort on training, increase its activity level, and review the training strategy in order to overcome the identified weaknesses.
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Chapter 9: Final discussion

9.1 Risk and safety: nothing or something

Safety and risk have always been an inseparable part of our life because of uncertainties, pressures and changes around us. From an existentialist’s point of view, to understand risk as a function of existence is a useful way to start the safety discourse. It is the fact that, before something can change or happen, it must first exist. If something comes into being or if something is required in order for change to take place then cause and effect is a function of existence. In other words, in the language of Ball (2004), it is about how one thing leads to another.

The concept of cause-effect is, itself, evolved from a fundamental phenomenon called the balance of nature. The fact is that, internally, there is an inherent equilibrium in most systems (Nicolis, 1989: 336, cited in Chapter 5). Externally, a system interacts with its surrounding environment so as to maintain a continuing, stable state of being. However, our activities can, and often do, disrupt or alter the balance of nature due to human errors, negligence, action or reaction, or other human and social factors. This disturbance might lead to enormous consequences (see Chapter 2).

Defining risk: between two cultures

Some theorists or risk specialists use the word "risk" in a way which is either too narrow or abstract for it to have any significant meaning or impact. Indeed, in the absence of concrete experience, any abstract meaning of risk does not hold in our mind very long.

The perception of risk divides, roughly, into two schools:-

First, it is the scientific view that places special emphasis on objectivity. As pointed out in Chapter 2, there is a long tradition to study the analytical underpinning of the idea of probability. It is about assessing the probability\(^\text{75}\) of a consequence, the likelihood of its occurrence, and the

\(^{75}\) See Chapter 2, Section 2: Risk perception and probabilistic bias.
severity or seriousness of the undesirable outcome or the hazard. The frequentist or probabilistic perspective, for example, is a typical view commonly held by some specialists. The approach of such analysis often involves a positivistic thinking which affirms science is the only valid source of knowledge about risk assessments and scientific analyses. The specialists of course are probably right to see that risk has two different parts. One is about the likelihood of happening and the other is about the consequence if it really happens. However, they often go in different directions and ignore some important social elements and personal perceptions.

Secondly, it is the self-regulating perspective that holistic thinkers tend to endorse. The move in this direction (e.g. as suggested by Peter Bernstein, 1996, as well as our government) is that people, inevitably, have to walk on their own two feet. They have to take responsibility for the consequences of their decisions, actions and behaviours. By law and by making safety as an externally imposed obligation (76), people can no longer remain passive in the face of an unknown future. The principle of solidarity (2) suggests that they have no choice but to begin to learn, develop their capacity and capability, and make decisions over a far wider range of identified hazards and uncertain circumstances within their ambit.

Implicitly, the capability development approach that I propose in this thesis supports the second view. Primarily, the approach is based on an idea that incorporates the principles of self-regulation, reflection, and fulfillment of self-directed, strategic goals.

**Probabilistic bias**

Risk is often concerned with our perception that something adverse will happen. Of course, views on risk are very diverse. Everyone, though sometimes reacts unconsciously, will try to reduce risk if it is known or readily perceivable. However, perception of risk is dynamic, situational, and socially constructed (see Chapter 2). Dealing with risk issues in our workplace thus demands some form of social learning, conceptual and scientific analysis, planning, and decision making, which are sometimes highly technical in nature. In practical terms, it involves designing and implementing practicable control measures and actions to mitigate perceived hazards. To deal with risk issues under uncertain circumstances is an inevitable struggle to overcome human inertia, conflicting values and goals. Some of the tales and case stories (77) in Chapter 2 attempt to convey a similar message. Developments in the theory of probability have indeed increased our control over risk. But I argue that “probabilistic bias” is always there to offset the reliability of our analysis and affect our way of seeing things.

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76 See explanation in Chapter 2, Section 3: Safety management as an externally imposed obligation.

77 For example, see Chapter 2: the “fable of the boiled frog”, the “butterfly effect”, the tragedies of the Space Shuttle and Piper Alpha.
An existentialist’s perspective

Risk is a terrible thing to ignore, because small things might lead to enormous consequences. Sometimes, these consequences can be extremely tragic. In my discussion about “how risks are coming into being” \(^{(78)}\), I would contend that, in our analysis, it is necessary to address the confusion or probabilistic bias originated from the traditional concepts of risk and from safety itself. I’ve used the word “chance” in a not strictly defined way but at least well understood in both English and Chinese language. On the one hand I’ve tried to clarify concepts such as probability and risk analysis (or assessment). They are believed by many scientists and experts to be quantifiable measures of randomness or likelihood of occurrence \(^{(79)}\). On the other hand, I’ve pointed out that risks are often not easily quantifiable, especially when ethics issues, value differences and other human or social factors are involved. Confusion of these basic conceptual differences introduces a great potential of “probabilistic bias”.

My view of “coming into being” is an existential-phenomenological philosophical approach (Langford, 2003) to the social psychology of risk perception. “How are risks coming into being?” is a novel philosophical question that allows us to explore risk issues which are common to all humanity. The question is related to the ways people perceive risks. It is a question inspired by my reasoning about existence and non-existence. It is embedded in the universal concept of “Yin and Yang” \(^{(80)}\). Although not specifically explained in any depth elsewhere (in this thesis), the “Yin and Yang” is my underlying thinking about the ways of relating things \(^{(81)}\). It includes the links between nothing and something, non-existence or existence.

From nothing to something

“From nothing to something” \(^{(82)}\) is a metaphoric expression as well as my basic philosophy that I’ve taken from Dao-De Tsing \(^{(83)}\), a classic Ying and Yang literacy, to explain when risks are coming into being. The expression helps us examine the process of evolution or change. In the process we can perceive or we might experience nothing significant to something highly disastrous. But, what we really face are uncertainties and changes. And, sometimes, we are not well-informed. Therefore, without unbiased analysis and an act of observation (e.g. seeing the

\(^{(78)}\) See Chapter 2, Section 6: What is the chance – when are risks coming into being.
\(^{(79)}\) See Chapter 2, Section 2: Risk perception and probabilistic bias.
\(^{(81)}\) See Chapter 5, Section 1: Introduction – “ways of relating”.
\(^{(82)}\) See Chapter 2, Section 2: Risk perception and probabilistic bias – a non-conclusion.
\(^{(83)}\) The Dao De Jing, by Lao-Zi, is one of the core texts of the Chinese way of thinking known as “Daoism”. In these early texts Daoism manifest as a sophisticated view of the world which mediates on the nature of the world.
dynamics of belief revision and influences of social factors)\(^{84}\), we can hardly see or understand how things evolve from nothing to something, even if there is something as small as a butterfly, a rubber O-ring or a small safety valve of a condensate pump \(^{85}\), which is neither obvious nor readily observable (see also discussion of the “butterfly effect” and the “putty problem” in Chapter 2).

In the course of human development, our time consists of a series of finite elements or events connecting one to another. Thus, in the chain of existence, the creation of transitions and connections between the tiniest links is the way our life is found to be. When there is a hitch at a certain point, we (not even the Frog) \(^{86}\) think of providing an appropriate response prior to a critical moment arisen out of nothing surprisingly abnormal. But, admittedly, the issue is one of accepting the reality that risk is always out there although we don’t know when it comes into being. It might be out of nothing obvious. Or, it is something not easily perceivable. It is something like a complex web, woven together with uncountable number of links. The web responds to changes in a dynamic way. A change in one link, no matter how small, will affect those nearby. Sometimes, a small change could cause the web to collapse.

We, as human beings might fear risk, but sometimes we thrive on it. Gambling, drug taking, rock climbing, space missions and adventures are risk taking behaviours. Adams (1995:16) claims from an economic point of view that “the starting point of any theory of risk must be that everyone willingly takes risk”. Some psychologists (many of whom were inspired by Sigmund Freud) examine these risk-taking behaviors from a psychological point of view. Some scientists or safety specialists analyze outside a probabilistic perspective (as just discussed). However, recent research findings shed a very different perspective on these behaviours. It seems that normal people are motivated to take risks as a result of situations they find themselves in. Risk can therefore be seen as socially constructed. However, what this thesis has been trying to address is in another stance, basing itself on a capability approach and confining the scope to workplace or occupational safety that affects almost everyone.

Because of the uncertain and complex nature of risk, we have to accept the fact that absolute scientific agreement cannot be achieved without any probabilistic bias. In order to effect the transition to change and, at the same time, to avoid unwanted surprises and possible tragic consequences, I share the view of Zimmer (1999) that what is needed is to empower

\(^{84}\) See Chapter 2, Section 3, for discussion about dynamics of belief revision, and Section 5, on the “ways of relating” risk and safety.

\(^{85}\) See explanation given in Chapter 2, Section 4, about the “butterfly effect”, the “putty problem”, the rubber “O-ring” and the “safety valve” of a condensate pump.

\(^{86}\) This refers to the “fable of the boiled frog” and the lesson that we might learn from the story.
people with the required knowledge, increased mental ability, expanded human capability and powers of their individual intelligence, governed by high standard of professional ethics. This is the position of my thesis as well as a point of departure for my journey of study in capability building and development. But, during the journey, one thing important we have to remember is that our individual position is similar to a link in the chain of development with which we are familiar. It is an integral part of the web.

9.2 Overall discussions

Using safety management as a platform of study, this thesis addresses some important issues of capability building that affect our way in shaping our safety destiny. The thesis gets beyond the old habits of working towards “minimum acceptable” compliance standards in facing the inherent challenge and misconception that safety is an obligation externally imposed.

The main object of the first part of my study (i.e. Chapters 1 to 6) was to place before readers my philosophical position, a working definition\(^{87}\), theoretical frameworks and, subsequently, a proposed capability approach for realizing our safety mission. The purpose is to establish capability building and development as a strategically important issue and to provide a theoretical framework for us to understand the process and its criticality in professional context. Given the strategic nature of the capability approach, the utmost need and basic prerequisite is to identify what to develop and what is critical. In my semi-structured meta-analysis of literature, a set of critical capabilities was determined, using a summative approach to collect referenced-based evidence from the past. The results of which are summarized as an inventory of critical capabilities (Table 4-3). As an example, the method of meta-analysis and the outcome of the study illustrate how the approach can be operationalized by developing such an inventory list to guide our development effort and outcome analysis.

I would, however, emphasize that the purpose of the conceptual framework is not purely theoretical, but practical. The empirical study and quantitative analysis have provided real insight into and understanding of how some important aspects of the approach can be made operational and how we can deal with the evaluative aspect\(^{88}\) of the approach (something has been left practically unresolved in other similar studies). The empirical research effort was to find the evidence that supports my hypotheses (Chapters 7 and 8). The investigation was essentially necessary for assessing capability maturity and proactiveness as a state of achieved functioning which is important for shaping our safety destiny.

\(^{87}\) See Chapter 3, Section 4 - Defining the safety management concepts

\(^{88}\) See discussion of evaluative aspect in Chapter 5, Section 4.
9.3 How can we shape our safety destiny?

As highlighted in this thesis, there are a number of important stances that help us shape our safety destiny. Most importantly, it is our risk perception that affects our way in which risk is dealt with. Perceptions are socially constructed. Thus what we learn and what we are capable of doing become important in shaping our perception which in turn affects our self-belief and confidence.

The purpose of scientific method, as argued in Chapter 2, is to develop and come up with agreements based on “truths” that are evident to everybody. The scientific probabilistic approach is based heavily on the use objective observations and rules of deduction. To deal with uncertainties and probabilistic bias, the methodology for subjective perceptions provides perspectives of each individual according to his or her abilities. With an integrated objective and subjective approach, according to my “Yin and Yang” perception, the rules of logic remain the same. The rules of evidence are subjective because of “probabilistic biases” that I’ve pointed out.

Redefining the concept of safety management

The evolution in defining safety management system (SMS) and the growing interest in promoting SMS over the past two decades suggest that safety management represents a key accident prevention strategy. In Chapter 3, I define SMS as a strategic management issue beyond what is sometimes mistakenly considered as an externally-imposed obligation rather than a basic human need. The management discourse and the way the issue is defined have a serious implication on how the resources are managed for the protection of people and control of loss. My belief, as with many egalitarians, is that safety is something beyond legal compliance. It is a basic human right. Surprisingly, such a fundamentally important issue has hardly found a place in any safety discourse. On the contrary, as a selling point, safety is often linked up with competitive advantages and business continuity from an investor or employer point of view. While the point appears to be sound, somehow it confuses the ends and means.

Based on the findings of an intensive literature review and safety management discourse, a working definition was derived as follows:

A safety management system is a systematic development and application of a combined set of technical, social, managerial functions and organizational capabilities, which can reduce the probability and/or consequences of potential hazards in a specific working environment. (See Chapter 3, Section 4)

89 A person who believes in the equality of all people.
Position taken in the development of SCD and assessment tool

My position about strategic development favors not only justice grounded on solidarity (90) but also criticality over the kind of resourcist criteria. And yet this argument is not decisive. It can also be resolved the other way, for example, by rejecting my position in favor of a commitment that promotes the criticality of strategic capability development (SCD) for other purposes beyond my current scope of study. For instance, in quality management, environmental management, strategic capability planning, and curriculum design, we might find the SCD approach and assessment method appropriate and useful as well.

To me, the basic purpose of SCD is to be strategic in making decisions in the process of developing a critical mass of capabilities, while allowing maximum development space to enlarge people's choices. People pursuing SCD often value achievements that will have sustainable, long-term impacts on people’s growth for achieving the desired state of well-being that people perceived as a worthwhile goal. Similar to those brought forth by other philosophers and egalitarians, such as Amartya Sen, the primary objective of development is to create an enabling environment for people to enjoy long, healthy, safe and creative lives. It is also about much more than economic growth (Mahhub ul Haq, 2004).

SCD, as far as safety management is concerned, is a dynamic process of development aiming to institute a critical mass of serviceable capabilities that enable a sustainable healthy and safe working environment or, in a wider context, to meet a set of well-constructed but ethically and socially acceptable long-term goals.

In the discussion of capability development, I suggest that being critical in formulating development goals, knowing what capability functionings need to be developed, and adopting a principle of strategic choice are the crucial ingredients of the SCD approach. In developing this suggestion, I focused especially on the fundamental question ‘development of what?’ (91) It was specifically in this connection that I assert the SCD approach by endorsing a resource-based view and strategic management perspective. To understand what this assertion might mean, we need to distinguish sharply between two different ways of approaching capability development. One way involves endorsing a criterion of criticality by applying the “contingency principle of criticality” in order to identify clearly and strategically what has to be developed. The other way involves endorsing a methodology and a set of criteria that, in the assessment of capability maturity, gives special attention to how the acquired capabilities are actually put into use.

90 See Chapter 3 for discussion about “solidarity” under the topic of “externally imposed obligations”
91 See Chapter 2, Section 5: the “ways of relating” risk and safety, for discussion of “Opportunity and Participation”
Contingency principle of criticality

My central assumption of the proposed capability model is that “competency and confidence” encourage more “competency and confidence” with mutual dependent and specifying effects. When a critical mass of capabilities has been acquired by an organization at an optimal level of confidence, it encourages critical capabilities to be further developed with leveraging effects. This way of changing and becoming, in my view, is a contingency principle of criticality applicable to any human development process. The challenge is to square the circle by somehow merging the two logics of criticality and contingency by redefining the roles of capability and thus ultimately the development and responsibility of the actors involved. In other words:

Contingent upon internal and external changes as well as resource limitations, a Contingency Principle of Criticality is the one that promotes strategic choice and critical reflection in achieving what people are actually able to do or to be.

This principle is based on a combination of theories, experience, intuition and arguments (see Chapters 4, 5 and 6). In developing the SCD approach, three interrelated characteristics of strategic capability are postulated: criticality, conditionality and coherence. It is, above all, a principle that involves active social learning, characterized by critical thinking and judgment not only about what has been done but a guide to future action for achieving a desirable state of well-being and functioning, be it about safety or any other desirable outcomes of critical nature.

The first postulation, as discussed in Chapter 4, is based on an understanding that criticality provides a critical constructive intellectual counterpoint to mainstream management practices. To be critical is to be sufficiently broad enough to serve as a source of critical reflection on central issues in management studies: epistemological issues, notions of rationality and progress, technological development, communicative action, human resource development (Alvesson & Willmott 1992: 11).

92 See Chapter 4, Section 4: What does criticality mean in the context of capability development.
93 See Chapter 4, Section 5: What are critical capabilities.
94 For discussion of “the concept of criticality”, see Chapter 4, Section 4: What does ‘criticality’ mean in the context of capability development.
95 The SCD framework derived from Sen’s approach can be conceptualized as a contingency model based on a radical concept that involves conditionality and highly variable degree of uncertainty. See Chapter 6, Section 1, for discussion of “contingency as a radical concept.
96 See Chapter 5, Section 1, for explanation of “parts with coherent reciprocity”.
97 See Chapter 7, Section 7: Capability development as a social learning process.
The second one, *conditionality*, refers to something conditional and situational. The implication is that each person’s interpretation of what is happening will depend on the ‘reality’ of his/her situation and influences imposed by the surrounding environment, including people he/she is working with. It is a radical concept inferred by the theory of contingency. Given the radically abstract nature of contingency (98) and conditionality, the proposed SCD framework provides a roadmap through multiple locations of contingency: conceptual and practical applications, strategic goals and actions, states of well-being and achieved functionings, causal relations, individual and organizational learning.

The third one, *coherence*, suggests that our human activities usually operate in a rather more flexible way than would be demanded by any coherent reciprocity principle. Evolution, coherence and reciprocity, as characteristics of the complex systems, provide the necessary conditions for the important mechanism of interaction and manifestation. This interaction and mutual dependence properties between associated organisms and their physical environment (as pointed out in Chapter 5), results in the formation of systems. As also pointed out in Chapter 4, capabilities are ‘talking’ silently to each other in a self-reflecting way. These critical capabilities are often less sure of their standing in our journey of capability development and, therefore, I feel there is a need to establish their presence. Thus critical capabilities, as the essential connectors, must be more explicit in their ways of relating to each other. These elements or connectors are parts of a “whole”, a “web” or a “critical mass” of things with a high degree of cohesion.

**Theory of mutual dependency**

The theory of mutual dependence is a law of the nature governing the “ways of relating” things to something else.

The theory suggests that any form of relationship, association, influence, correlation, link, or connection between things (e.g. human beings, objects, ideas, thoughts, concepts, perceptions, artifacts, ways of governing, controlling, shaping and reforming, constructing and reconstructing; ways of formulating and testing hypotheses, ways of putting forward arguments and propositions, justifying things with evidence or arguments … etc.) are contingent upon the nature and property of their existence as well as their interaction with their surrounding environment and other things in existence.

On the contrary, the theory of mutual dependency suggests a concept of independence as a sub-set of mutual dependence. This independence presupposes the principle of distinction. In a

98 See Chapter 5, Section 2 – Relating contingency perspective and action theory to capability development.
“Yin and Yang” way of thinking, independence is a distinction from dependence. But conceptually they are interrelated in a complimentary way to become the whole reality. Without dependence there will be no independence. However, without realizing the meaning of dependence we cannot see the value of independence as the superior way that Mahatma Gandhi was advocating in his fight for freedom.

How does this theory of mutual dependency come into being? The key concept is the “ways of relating” things (99) and how things come into being (100). The theory that I postulated in this thesis simply tells us the truth that things are there already to be seen or unseen. The fact is that they are either related or unrelated, depending on the surrounding environment and the other things (or factors) in existence. It also depends on our focus of attention and how we choose to understand the situation. Nevertheless, things come into being either dependently or independently. Things may come into being from nothing to something (e.g. at the beginning of our universe). Here below are some examples that I’ve discussed (or described) in this thesis to justify the claim.

The question about “two cultures or one” in Chapter 2 is about Charles Snow’s insight and his understanding about the vast gap and relation between two cultures of scientific enquiries. Donald Schön and Chris Argris’ professional development and action theory is influential. The great virtue of their work is their extensive research into how individuals and organizations learn – or fail to. In other words, it is something about how things might evolve from one thing to something more important. Similarly, Peter Senge’s organizational learning theory teaches us how to expand our capacity to create the results we truly treasure. These contemporary theorists show us how to think or philosophize in the postmodern world. They provide a positive philosophical or theoretical response to the fragmentation and dissolution of our professional life. These philosophers, theorists or management gurus adopt many different literary forms, sometimes within the same work. Their investigation is at once dialogical, confessional and, most of the time, their work involves understanding of human beings and how one thing leads to another. This “one thing leads to another” or “from nothing to something” is implicated by the theory of mutual dependency as something fundamental in our road to excellence.

This suggests that capabilities are mutually dependent and support one another. Using safety management as a study platform, this study brought markedly from literature the critical safety capabilities to the table, creating an understanding of mutual dependence that strengthens

99 See Chapter 5, Section 1: Introduction – “ways of relating”
100 See Chapter 2, : How are risks coming into being
our understanding of the relationships between the capacity determinants. The findings of my empirical study on the interplay between capabilities suggest that this mutual dependence does exist. Statistically, the empirical findings support the main hypothesis that critical capabilities are mutually dependent (see Chapter 8, Table 8-7 and analysis in Section 7). The result of hypotheses testing (H2) suggests that critical capabilities and proactiveness are also interrelated. For instance, risk management capability does have a significant influence on the overall proactiveness (as illustrated by the results in examining the relationship between the frequencies of goal-setting, risk management, safety training, operational/administrative activities, as well as the overall safety proactiveness index). The results make individuals becoming aware of his or her capability through the processes of self-evaluation. In addition, by reviewing the level of proactiveness in terms of activity regularity (or frequency), one might discover how often an acquired capability is used and how proactive one might take his or her course of action in dealing with safety issues.

However, there is an exception. In the analysis, some inconsistency was observed in examining the relationship between goal-setting capability and proactiveness. The observed inconsistency might be a result of value difference or goal incongruence from an individual or organizational perspective. Maybe the manifestation of acquired capability is not without conditions. Value difference is certainly one of these limiting conditions that affect how goal-setting capability is put into effective use. Proactiveness related to the use of goal-setting capability is often influenced by other social factors. Goal-setting is sometimes irrational, causing conflicts amongst employers and safety personnel, particularly in dealing with safety obligations that are sometimes taken as externally-imposed. Therefore, it is not surprising to see the null hypotheses (H2a, H2b and H2c) being supported because goal-setting is a highly individualized decision-making ability. According to Locke’s goal-setting theory, individuals make calculated decisions. Once individuals determine their goals, these intentions direct and motivate their efforts to achieve what they have decided upon. Thus, setting goals affects behavior of the individuals and their performance. (Locke & Latham, 1990).

**Relationship between self-efficacy and proactiveness**

Bandura observed that efficacious beliefs influence more than just the specific area of inquiry:

> The belief in one’s capability to exercise control over one’s own functioning and other events that affect their lives is instrumental in life choices, level of motivation, quality of functioning, resilience to adversity, and vulnerability to stress and depression (Bandura, 1994, p. 14)

Perhaps the findings of my empirical study best sums up the important relationship between self-efficacy and proactiveness when commenting on what one believes affect the level of proactiveness. People who are high in self-efficacy believe in their ability to accomplish what
must get done. People who are low in self-efficacy tend to avoid doing a job. People using an inactive approach try to avoid problems and wait for them to go away on their own. Reactive people approach safety by solving problems with solutions that have worked in the past. Proactive people are the ones that try to learn to become better. (Daft and Weick, 1984). Thus, it can be concluded by observing this part of the findings that the belief in one’s capability to exercise control over one’s own functioning is instrumental in choices and proactiveness, if proactiveness is a function of motivation. This conclusion, I would say, is line with Bandura’s observation stated above.

9.4 Capability building

To shape our safety destiny, the “Strategic Capability Development” (SCD) approach is argued and proposed as a whole new way of thinking about how to manage limited human resources, basing itself on the three concepts: (1) strategic choice, (2) critical capability, and (3) critical functioning. (101) Applying the philosophy of strategic management and principle of criticality in “changing and becoming” creates a whole new philosophy for my SCD approach. Perhaps I am overselling the novelty of the approach somewhat. However, for optimization of performance (102), it is hard to imagine any rationalization of capability development or safety strategy without these ingredients. The central point is however not these three concepts but what logic is guiding their application. In the words of Secretary Chertoff: “whenever we make a risk analysis, we have to also make a cost benefit analysis” (Chertoff, 2005: 20).

In the development of the SCD, my attention was turned in a direction towards those findings and solutions suggested by our predecessors, as well as a continuing process of deconstruction and reconstruction of our beliefs and values by reviewing the safety management (103) and capability (104) discourse. This thesis shows one of the possible ways to break our educational enclosure in which professional edifice can be established, walled, and proudly defended on basis of the knowledge that has already been there. The way that I propose is, on one hand, an approach based on Amartya Sen’s capability approach and related management theories, and, on the other hand, an inventory of critical capabilities (see Table 4-3) through meta-analysis (105) of relevant literature. The work has laid the theoretical and methodological foundation on which critical reviews and improvements can subsequently be made. Where and

101 See Chapter 6, Section 5: The SCD – making capability work.
102 See explanation about the meaning of and distinction between ‘capacity’ and ‘capability’ using the metaphor of “water dam” (Chapter 4, Section 3 – On the nature of “capability”)
103 See Chapter 3: How do we shape our safety destiny – a safety management discourse.
104 See Chapter 4: Building critical capabilities for leveraging human potentials.
105 See Chapter 4, Section 9: Meta-analysis of literature: identification of critical capabilities
when occasion shall require, the inventory list of critical capabilities can be made and maintained on this basis with a continuous review of what is really needed.

**Capability approach from a resource-based perspective**

My belief in capability building and development had an epistemological origin. It was founded on the *contingency principle of criticality* (see discussion in Section 2.2). It is built on an understanding that building critical capabilities involves identifying strengths, weaknesses, opportunities, as well as strategic priorities.

As pointed out in Chapter 3 (Section 7), *being strategic is important* from a resource-based perspective. While established management functions rely on existing capabilities and past experiences to structure their operations, new management functions (such as safety management) become problematic to the extent that critical requirements fails to be specified in ambiguous situations. With uncertainties and the absence of concrete experience, building of new capabilities has to start from scratch. Thus strategy formation might rather be conceptualized as unconscious and sometimes imaginative, only partially relying on available published guidelines or codes of practice, for instance, by the government or regulatory bodies. But while this understanding has certain descriptive power, it is of limited analytical value, since it turns strategy formation into a black box. In getting out of the box, one of the solutions is to encourage transparency and shared understanding through a broadly-based participation (106).

**Extrapolation SCD to a social learning context**

Drawing on the above discussion it appears possible to maintain that the ontological realism presents in Social Cognitive Theory (SCT) may engage in fruitful interaction. It may, however, be possible to argue that SCT, in fact, departs from traditional ways of objective evaluation (e.g. skill tests, trade tests, written examinations, etc) because the properties of acquired capabilities are exclusively socially constructed. However, for the purpose of this thesis, it is the interpretative flexibility suggested in SCT that is the main interest, while its bias towards objectivity appears less productive.

Furthermore, if those most at risk (for example, workers themselves) continue to be excluded from the safety management processes, such as safety training and development of personnel, then this incalculably important source of safety expertise made available by the key safety personnel cannot be fully utilized. Unless a change of safety training strategy occurs, there appears to be little chance of mainstreaming safety into the business operations or other

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106 See Chapter 4: Building critical capabilities for leveraging human potentials.
management functions. For high risk industries, if this situation continues then the likelihood of another Piper Alpha (107) tragedy or Longford Explosion (108) occurring will also dramatically increase.

To bridge the gap, it can only be done by making safety training our top priority (see Chapter 4, Section 9, the literature findings of my meta-analysis study), and by reconstructing our knowledge and understanding about risk and workplace safety (Chapter 2). We should revolt to think in light of uncertainty and complexity that might affect the successful implementation of an innovative training strategy or the proposed capability approach - SCD. Let us remove the protection from our state of being complacent. A safe place now cannot guarantee it will be safe in the future. Be aware that a workplace once safe may henceforth become endangered by our complacency – a wisdom derived from the Yin and Yang principle. In fact, being complacent is by itself an inherent risk that nobody can easily discover.

Furthermore, the findings suggest that there was a general weakness in performing safety training tasks, especially in reviewing strategies and training needs. Insufficient attention was paid to the role of safety training and capability development in shaping appropriate safety/risk awareness and responsiveness of the others. To achieve a desirable state of workplace well-being, relying on the efforts of safety practitioners is simply not enough. Without the required safety capabilities, it is difficult, if not impossible, to ensure optimization of organization effectiveness in managing safety at work. However, shall we put everything onto the shoulders of safety practitioners? Some aspects of my research findings (see Chapter 8, Section 11, Activity Profiles) concerning safety training suggest that present safety training activity level is relatively low in comparison with other strategic areas, and there is a need to make decisions to alter the fundamental basis of the safety training strategy with a contingency perspective.

The implications of this contingency perspective are:

1. To enhance organizational capabilities for sustainable safety advantage: Through a capability-based training strategy, organizational safety capability can be ensured. In most cases, the research findings suggest that safety practitioners assumed themselves as the prime driving force in matters of safety, but failed to develop the required organizational capabilities that take human resources beyond their role to become important parts of sustainable and evolving safety edge.

107 The Piper Alpha oil platform disaster left 167 dead in 1988 [see Lord Cullen’s public inquiry report (1990)].
2. **To become more strategic instead of focussing too much on operational details:**
   
   Fundamental to engaging strategic choices in the SCD process is building critical masses of capabilities — the range of important things that people can do or can rely upon. The most basic capabilities for safety management are identified in Chapter 4, which are essential for developing a critical mass of safety management strengths that the rest are based upon. Without a critical mass of relevant capabilities, many choices are simply not made available, and many opportunities of safety improvement remain inaccessible.

**Overcoming organizational capability deficit**

In light of the argument justified through the literature, I would contend further that an organization that fails to respond in a strategic way towards capability building will find itself gradually losing ground. This inability to generate the required *capabilities* will contribute to building an "*organizational capability deficit*". Ultimately this capability deficit will put its very existence into jeopardy. However, normal human inertia makes it rather difficult to effect the desired changes, even when the need is loud and clear. As a starting point, one might find it particularly useful to ask: “What to develop?” and “What is critical?”

Readers may find, as an example, the Critical Capability Inventory (Table 4-3) particularly useful for similar applications. It provides an answer to “What to develop?” as well as “What is critical?” It is a robust inventory of capabilities, summarizing the key objectives of safety management capability development. By leveraging the strategic nature of the inventory, the template and its content can help course planners, developers and human resource administrators streamline training development, enhance goal congruence for teaching and learning, and facilitate outcome evaluation and monitoring.

The inventory provides a simple means of classification and a concise typology of what is strategic and what is operational, what are general capabilities and what are specific skills or competencies. Aggregating validated information into a concise list of capability inventory, educators or training developers can proactively address capability development issues, expedite the analysis training needs, and decide upon what to be observed or measured. Pedagogically, it provides a useful reference frame for setting learning objectives, and differentiating between desired learning outcomes regarding what is critical and what is supplementary. Importantly, by aligning learning outcomes with desired capability functionings, it makes explicit a paradigm shift towards a capability-oriented program. Although developing capability-based curricula was outside the scope of this study, I’m sure the work here shall open up a series of debates on the implications of the approach and methodological issues.
9.5 Taking the pulse

The research problem – how do we shape our safety destiny using a capability approach – flows directly from some of the critical issues of safety management (Chapter 1). The first part of my study focused on finding out what capabilities are critical to safety management success and the second part deals with ‘taking the pulse’ – a snapshot of what is now. Indeed, the study variables – critical capabilities and regularity (frequency level) of activities were found to be not mutually exclusive but they were explicitly identified within the concept of SCD (see Chapter 6, Section 5). The framework of SCD, because of its universal nature, is not a model exclusively for safety management. It is a conceptual model which can be thought of a shared framework and unified approach.

Methodological issues

As far as measurement is concerned, assessment of human capability seems surrounded by a mystique of undefinability. Yet quantitative measures of capability, in the sense of people’s self-evaluation of whether or not they are capable to perform or act, is by no means an unachievable empirical realm.

The self-efficacy approach to the measurement of capability maturity provides a novel framework for resolving some of the evaluative aspects of the capability approach. As discussed in Chapter 6, capability assessment and the design of the Safety Management Efficacy Scale (SMES) were grounded on Bandura’s social cognitive theory. The theory infers that perceived self-efficacy is people's beliefs about their capabilities to produce designated levels of performance that exercise influence over activities or tasks. Social cognitive theory lends itself readily to personal and social applications, which has been extensively reviewed over the last three decades. I used this theory as a backdrop for my empirical study because of its well proven predictive and interpretative power. According to the theory, individuals may perform differently with the same set of skills depending on the beliefs they hold about their capabilities in given situations. This causal relation is assumed when I designed the SMES survey instrument.

The findings of my empirical study suggest that the utility of the SMES, coupled with the activity survey, provides a more reliable means for the assessment of capability maturity. Despite strong differences between efficacious perception on goal-setting capability and associated activities, it is clear that there is a fundamental relationship between critical capability and proactiveness. It is evident from the findings that proactiveness is strongly influenced by the critical capabilities, for example, risk management. Similarly, by comparing the capability maturity profiles (Chapter 8, Fig. 8-5) with the activity profiles (Chapter 8, Fig. 8-6), one can
easily identify the strengths and weaknesses of individuals, groups, organizations or the profession as a whole.

Acknowledging the fact that formulating safety policy, synthesizing and analyzing safety/risk information, solving safety problems, designing safety devices, preparing safety manuals and safety operation procedures, writing accident reports, facilitating safety committee meetings, carrying out routine safety inspections, are typical tasks of safety practitioners. But they are not all equally important or critical. A great number of writers have alluded to the primacy of safety management, for example, management commitment and support, staff participation, risk management, safety culture, and organizational climate. However, no particular claims have been ever made to justify which one comes first. The literature study, using meta-analysis, suggests that history-taking with an accumulative approach (see Chapter 4, Section 9) is a reasonable quest for mediating which activity (or task) is more critical than the others. The study in this regard has led to a set of critical capabilities classified in the following order of significance:

1. Goal Setting
2. Risk Management
3. Safety Training
4. Risk Communication
5. Operational/Administrative safety activities.

Capability is a critical mass of multi-capabilities. Amongst the related capability sets, they are characterized by a high degree of coherence and mutual dependence. As can be seen in this study, the variables are related and the correlations between them are significant, regardless of their type, because the *r*-values of those variables that I compared are distributed in a consistent manner in the sample of observations. In other words, the indicator variables are related because their values systematically correspond to each other for these observations. Efficacious perceptions of capability is therefore considered to be strongly related to each other and characterized with a high degree of coherence according to the outcome of the related analysis and reliability tests conducted in this study (see Chapter 8).

**Evaluative aspect: self-efficacy, capability maturity and proactiveness**

The research findings were linked to some aspects of the research problem, which set the context for this capability study using safety management as a case. The SMES method is grounded on Bandura’s social cognition theory – a theory which suggests that: “Reasonably precise judgments of capability matched to a specific outcome afford the greatest prediction and offer the best explanations of performance outcomes, for these are typically the sorts of judgments that
individuals use when confronted with behavioral tasks” (Bandura, 1986). Bandura’s theory, which focuses on the evaluation of self-belief related to capability, predicts that individuals with certain strengths are better capable of undertaking the related tasks on a more regular basis. In other words, capability is implicated as a possible factor that affects work priorities and proactiveness.

My design of the research instrument, SMES, in assessing the maturity level of critical capabilities is consistent with my concept’s representation in the SCD approach (Chapter 6) and the theories of the others, for example, Amartya Sen’s seminal work (109). The major difference is that, for abstract qualities such as freedom, happiness, environmental health and innovation, Sen has created programs and policies to fit the easily available economic numbers while ignoring the other abstract measures that are very difficult to assess. In my case, for the measurement of capability maturity, the indicator variables were based on a set of critical capabilities. The measurements of which were quantified as a set of self-efficacy scales. Together they form the assessment criteria of the SMES.

Capability, in particular its maturity level, is complex to measure. In its origin, capability is based on knowledge, skills and competence developed over a period of time. Capability can be regarded as the outcome of a dynamic, interactive learning process, involving acquisition of knowledge, skills, abilities, competencies, expertise, and intellectual qualities, as well as the ability to put them into effective use. The measure of such qualities is difficult if not impossible. It is because we do not have any yardstick. Another problem is to understand how well the use people made of these acquired capabilities. In light of the complexity in measuring capability maturity, the scales on both sides of the assessment items (110) are tipped in favour of indirect realism (111) by evidence that there are important relationships between self-efficacy and proactiveness.

In the construction of the survey instrument, a dual-scale system was applied. On the right hand side of the questionnaire, it was a set of safety management efficacy scales, and on the left hand side, against the same assessment items, there was a set of scales for assessing the activity levels of corresponding tasks. In constructing the scales for the activity survey, I considered it especially important to include an evaluation of proactiveness by assessing the

109 Amartya Kumar Sen (born November 3, 1933) is an Indian (Bengali) economist best known for his work on famine, human development theory, welfare economics, and the underlying mechanisms of poverty. He received the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel for his work in welfare economics in 1998 and the Bharat Ratna in 1999. (Source: http://en.wikipedia.org/wiki/Amartya_Sen)

110 See Appendix 4: Questionnaire - Safety Management Efficacy Scale.

111 Indirect Realism is the view in cognitive psychology that perception functions via internal representations of external reality.
activity level while self-efficacy is being assessed. The activity survey involved a reflection of how often a safety task was performed. In trying to provide an answer to the question, people would begin to recognize that such assessments are judgments and that people are likely to have different perspectives, depending on their prior experience, knowledge, belief systems, and values.

Through the survey, we can see the power of self-belief and its influence in shaping judgements. Respondents are especially sensitive to the importance of risk related activities that can relate to their safety experience as a safety practitioner. From the findings, it can be seen that self-efficacy creates a perception of indirect realism, even in a subtle way while other elements (e.g. goal-setting, risk communication) are characterized with a pretty abstract quality. As indicated by the activity survey, self-efficacy has an important role in influencing priority of action because people who believe they are efficacious tend to be proactive as resulting from high ability, and reactive as resulting from a lack of confidence.

When it comes to the assessment method using self-efficacy scales, one may argue that the distinction between belief and action is false. However, with a dual-scale system, SMES is claimed to be active along two dimensions for evaluating self-efficacy and proactiveness at the same time. By extending between a priori distinctions between belief and action at one end and radical symmetry at the other, we can provide assessment for two interrelated attributes (efficacy and proactiveness) simultaneously. Possibly, this emphasis on symmetry may be seen as both a strength and weakness of the survey instrument. However, such an approach may facilitate an understanding of the interaction and inconsistence between self-belief and action (or activity) involved. It also helps resolve the assessment issue of how well the use people made of their acquired capabilities and how capability maturity in terms of self-belief is related to proactiveness.

In other words: by knowing our capability and its level of maturity, we can be confident of how well our specialists are regulating risk in this place. With the status made known to us, we can either be confident or we can catch up to make the administration and control of risk much better than what we have used to be.

9.6 A pre-conclusion

When people are nice and dry in their comfort zone, they often see nothing is dangerous unless they are absolutely sure they have seen the smoking gun. While risks are somewhere out there to be found, some accident rates are scaling new heights. Under public pressures, governments are bound to defend themselves that they have been regulating the undesirable outcomes through
legislation for a long time. It is natural that the government department(s) concerned would claim that it has been a good steward of occupational safety. Who then should take the blame?

This is, by the way, why we should worry that in matters of safety we seem to trust the specialists (e.g. our safety professionals) more than anyone else. Specialists are trusted but not always accountable, whilst the CEOs or senior management are accountable but sometimes distrusted. Both the trust and mistrust are largely misplaced. But as soon as something goes seriously wrong (e.g. a space shuttle blown up in the air or another similar tragic accident takes place) the honeymoon will soon come to a dead stop. Would it be wiser to take the risk and deal with it in our own right by understand what risk is all about, and (as suggested by Peter Bernstein, 1996) deal with it ourselves. We have no choice but to begin to learn, develop our capability, and make decisions over a far wider range of identified hazards and uncertain circumstances. It is the fundamental issue that SCD is trying to address.

In the end, we ought to consult all we know or have reason to believe when forming and testing hypotheses, and when evaluating the plausibility of our hypotheses. Of course, the proposition of mutual dependence is intended to describe how things are related to each other, and specifically the relationship between capabilities that are collectively identified as a critical mass. Within this critical mass, what then is the centre of gravity for the other elements to orbit around. In the final analysis, according to the findings of the SMES and activity surveys, risk management is one that matters most.
Chapter 10: Conclusions, implications & directions for future research

10.1 Final conclusions

This thesis revolves around two main areas of academic interest – i.e. strategic capability development and evaluative aspect of the capability approach. A significant part of this study was a meta-analysis of the safety management literature to generate a Critical Capability Inventory. The capability approach and the Social Cognitive Theory of prominent stalwarts in these areas such as that of Amartya Sen and Albert Bandura were also discussed. This work was then extended to examine a Capability Maturity Model and the further development of the Safety Management Efficacy Scale (SMES). The development and final testing of two hypotheses suggest a strong relationship between safety management capabilities and goal setting capabilities, and a similar relationship between proactiveness and critical safety management capabilities.

In managing safety at work, “building capability” and “taking the pulse” are two sides of a coin. In a wider context, human capability development and the scope of SCD applications are ever expanding. I have therefore coined a new word “Capagogy” to highlight the importance of strategic capability development in light of its relevance to risk management and other developmental processes.

SCD as a sustainable safety solution

Using safety management as a platform of study, this thesis has shown that safety management capability development can lead to increased safety capability which in turn enhances safety performance. As discussed in the previous chapter, one might be able to realize that a well constructed capability approach, basing itself on strategic development and

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112 Capability theory, contingency theory, resource-based theory and, in particular, Amartya Sen’s capability approach, Peter Senge’s learning organization, and Donald Schon and Chris Argris’s professional development and action theory. (Chapters 3, 4 and 5 refer)
implementation, can help minimize the possible impact of “organizational capability deficit” on the overall or individual safety functioning of an organization. Hence, based on these premises, I recommend that the SCD approach be considered as a useful alternative for providing a long term, sustainable solution for shaping our safety destiny.

By adopting the SCD approach in managing safety at work, I do not mean given up the wisdom of our safety traditions. Instead, all these useful norms and good practices will become part of the consideration in making strategic choices. With the proposed SCD, people will find the method more focused and responsive to individual or organizational needs. The approach comprises suitable integration of processes from strategic goal-setting to development of core capability sets for achieving critical functionings and optimum workplace well-being.

Whether it does so in all situations (e.g. in managing safety and risk), or whether this might be possible, is far from clear because evidence is far from adequate from an empirical point of view. However, from an ontological point of view, there is every reason to believe that the approach of SCD could make a bigger impact with more, and more precisely focused effort towards some worthwhile safety goals. This latter point is important, since it suggests that improving the precision with which safety effort in developing safety management capability is made, has the potential to enhance safety benefits for making the state of workplace well-being more sustainable than the traditional compliance-based (but less focused) methods. However, it may be better to think of the opportunity as distinctive ongoing improvement and reflection through continual realignment of capability sets with what is really needed. Furthermore, the suggestion of being strategic, proactive and critically reflective is something unique for the operationalization of SCD rather than facing a catch-up, deficit or loss-control situation.

Critical determinants of safety success

Risk exists everywhere but it varies from place to place. Based on a contingency perspective and the argument given, it is clear that there is no single form of management capability that enhances safety performance in the same way in all situations, and no single best way in which management development creates this capability. Rather there are many different forms of management capability development that can generate many different forms of useful capability, which in turn can increase performance in different ways.

Nevertheless, in dealing with safety issues in the workplace, there are some critical elements which have proved to be more important than the others. The findings of the meta-analysis of literature suggest that (1) safety training and personnel, (2) risk management and hazards control, and (3) communication and feedback, are the top three most critical
determinants of safety success. These, if properly designed and implemented through the proposed SCD approach, will have significant influence on safety culture as well as long-term impacts on safety performance.

Taking the pulse

Where are we now? As argued in Chapter 7, self-belief, in the context of “belief-action” relation, represents a relation between a person’s belief and the expected outcome (see also discussion of “outcome expectance” in Chapter 2, Section 5). While it is clear that developing the required critical capabilities can enhance safety management efficacy in the long run, the empirical part of this study stresses that this is not currently being achieved to maximum effect in the safety profession (see Chapter 8). The findings suggest that the respondents’ general safety training capability was relatively weak. Here is a weak point that implies a lack of attention to employee development and participation, without acknowledging the considerable benefit that safety training could provide.

It is also clear that capability not only resides with individuals but also a collective management capability that affects performance and transcends individual capability. This theoretical assumption is becoming more widely supported in the embodied cognition and capability literature (113). Although previous research findings and evidence are strong enough to support this view, there is not much about what to develop and what capability practices to adopt. There is in general a policy and practice gap to be filled in the development of safety management capability, and a gap in the evidence-based research to steer this process.

In general terms, human resource development processes that link management capability and utilization with organizational strategy and processes are critical to reaping the performance potential of management capability. As an extension of this point and based on the findings of the current empirical study, it is clear that not all the core safety management capabilities are fully acquired or confidently implemented by the respondents. Part of the reason might be that safety management has only a very short history in Hong Kong. Building a safety culture takes time, but creating a learning culture, expanding human capacity, developing capability edge, and building the right capability by the right people is definitely the worthwhile long-term goals.

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113 See elaboration and literature review in Chapters 4 and 5.
Relationships between self-efficacy, capability and proactiveness

Perhaps, as a side issue but an important one, it is clear that the belief in one’s capability to exercise control over one’s own functioning is instrumental in choices of work and proactiveness. This part of the conclusion, I would say, is line with Bandura’s observation (Bandura, 1994:14). In sum, people who are high in self-efficacy believe in their ability to accomplish what must get done. People who are low in self-efficacy tend to avoid doing a job. People using an inactive approach try to avoid problems and wait for them to go away on their own. Reactive people approach safety by solving problems with solutions that have worked in the past. Proactive people are the ones that try to learn to become better. The relationships between self-efficacy, capability and proactiveness are clear and positively delineated. The emphasis is on building the ‘water dam’ (114) rather than focusing on the ‘water’ contained therein. Keep building the ‘dam’ within limitations and contingency factors is the story I’ve been trying to tell.

Strategic capability development

Critical capabilities are not static. They must be dynamic with the ability to address rapidly changing working environments. The proposed SCD approach aptly addresses this dynamic issue with the capacity to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments, especially in the context of safety management.

Putting it all together, Strategic Capability Development to me is:

(1) the notion of the need to be critical, strategic and reflective in identifying and specifying development criteria, for instance, a reliable set of validated critical capabilities to facilitate planning, implementation and evaluation (see Chapter 4, Section 9, and Table 4-3);

(2) a decision making process, involving the application of “Contingency Principle of Criticality” that promotes strategic choice in achieving what people are actually able to do or to be, and it is contingent upon internal and external changes as well as resource limitations (see Section 2.2);

(3) a development process grounded on three postulations: criticality (115), conditionality (116) and coherence (117) (see discussion in Chapter 9);

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114 See the “Dam Metaphor” in Chapter 4, Section 3: On the nature of capability.

115 For discussion of “the concept of criticality”, see Chapter 4, Section 4: What does ‘criticality’ mean in the context of capability development.
(4) a human capability development process, the approach of which is based on the belief that “competency and confidence” encourage more “competency and confidence” with mutual dependency and specifying effects (see Section 2.3); and

(5) the involvement of a novel evaluative method, based on the Social Cognitive Theory, for “taking the pulse” (see Chapters 7 and 8).

In general, the implications of the approach are:

- The engagement of people in identifying and expanding capabilities important to them is fundamentally a basic necessity.

- This engagement engenders and validates people’s values, beliefs and self-efficacy.

- This engagement, in professional contest, calls for strategic thinking. It also involves learning, which is social, strategic, and reflective.

- This engagement of people in ongoing learning is dynamic and situational. But setting strategic goals is a fundamentally important point of departure for any development endeavour.

- Specifically, in matters of safety, capability development is an entitlement of people at work because safety is a basic human right. For organizations, within the concept of solidarity, it is a social responsibility.

**Implications of conclusions for practicing safety leaders, educators and policy makers**

In practical terms, the SMES, with the identified critical capability sets, offers an instrument for evaluating the strengths and weaknesses of safety practitioners by assessing their self-efficacy. It provides a solid tool to ‘take the pulse’ of capability building for managing safety at work. As it is turned out, the SMES provides not only an alternative means for capability assessment, but can also be used to evaluate educational or training needs. The SCD and the resulting theory together provide a point of departure to conduct similar or related research on capability building and evaluation, including but not limited to human resources development, people capability maturity assessment, training / curriculum development, and performance evaluation.

The management capability development that contributes most clearly to performance enhancement is that carried out by the key players or stakeholders (such as the safety managers

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116 The SCD framework derived from Sen’s approach can be conceptualized as a contingency model based on a radical concept that involves conditionality and highly variable degree of uncertainty. See Chapter 6, Section 1, for discussion of “contingency as a radical concept.

117 See Chapter 5, Section 1, for explanation of “parts with coherent reciprocity”.
or safety officers) who are key drivers and decision makers better informed than the others. However, it is more difficult to establish this effect for training or education efforts further back in the history producing value chain, as they affect the development of people and the alignment of capability with worthwhile goals and objectives. While there is no reason to doubt that education in many forms contributes to capability building and development it is more difficult to prove and to assess which parts of it make the greater contribution in the general process of human capital and capability development.

In this particular case of safety management study, practitioners generally placed more emphasis on operational activities than strategic issues, while ignoring the fact that strategic safety management helps foster the evolution of sustainable safety climate, and nourishes appropriate responsiveness to the need for developing new capabilities through training and personnel development. Unfortunately, practitioners’ general acceptance of their operational role will play a major part in the slackening of the safety responsibility of other people in the organization.

Developmental patterns seem to be associated with career progression from the beginner level to proficiency level. In relativism, experience and job position continue to influence practitioners self-efficacy and their proactiveness. As they reach higher levels of their career development, they gain experience and confidence, resulting in enhancement of personal capability. As revealed by the empirical study, people with senior positions are more likely to hold high self-efficacy belief regarding what they are capable of doing. For instance, amongst the targeted groups, safety managers scored the highest ratings in various dimensions of assessment concerning their self-efficacy.

If the SCD approach is understood as merely delimited to the measurement of self-efficacy, it may be deemed as pertaining to the domain of naive realism: ‘What you belief is what you do’. However, the assessment approach discussed in this thesis is explicitly extended to comprise also activities and their respective regularity (i.e. frequency level of activity). Moreover, the interlinks between different forms of capability are also included into the approach. The assessment approach is, therefore, dedicated not only to realist evaluation of action in practice but also conceptualization in relation to non-observable mechanisms and structures, such as self-beliefs.

In more specific terms, the empirical work of this study has provided statistically significant evidence to support the main hypothesis that:

(1) Capabilities are mutually dependent and complimentarily supporting each other
(2) Risk management capability is identified as the most critical competence set that has the strongest correlation with the other capabilities.

(3) The more people are capable of managing risks the more they are able to enhance their capability for achieving the desired safety functioning and well-being.

The implications of the above findings are:

(1) The SCD model appears useful to provide a unique guidance for capability building and development. The emphasis on human resources development and strategic choice has been found to be a useful model for structuring capability inventories, self-ratings, competencies, and activities in the design of the research instrument (i.e. the SMES).

(2) Strategic capability inventory is a kind of portfolio, providing a new code for professional development, capability building and self-evaluation. With such a portfolio, it is possible to provide (a) a picture of work and future direction, (b) consistent values, (c) consistent competencies, and (d) greater self-confidence. Thus, the practitioner will most likely tend to make good choices of professional development strategies and to function effectively even in compatible environments.

(3) Educators should construct and utilize critical capability inventories as teaching/learning inventories because the choice of teaching/learning objectives is an expression of the desired learning outcomes strategically in alignment with the development needs of individuals and our society in a particular field or discipline.

(4) Educators should also include the following in their educational programs: (a) employability capabilities, (b) beginning capability awareness, (c) self-awareness and evaluation, and (d) assessment of capabilities acquired by the learners. In addition, utilization of capability inventories can result in educators aiding individual learners in making realistic, strategic choices to enhance their strengths and to overcome their weaknesses.

(5) Moreover, individuals can use a well-defined set of critical capability inventories to identify their capability gaps in making realistic, strategic choices. They can then be more productive in their learning if they can be able to focus on essential knowledge and skills for their professional development.

One might argue that development of capabilities may not be the secret ingredient that guarantees superlative organizational performance. But, without an understanding of the strategic nature of critical capabilities and its implications, superlative performance over the long term would be very unlikely. In the end, it would be useful to think of management capability together as a critical mass or a coherent set of critical capabilities essential for achieving desired outcomes.
Similarly, the same concept of capability development and the SCD approach can be applied to different aspects of management processes, for example, quality management, environmental management, human resources management, etc. Management activity in local context (and elsewhere) is substantial and the quality of capability is difficult to assess. The assumption is that weaknesses in management capability is not a source of competitive disadvantage in economic and social terms, but that if focus attention is given to capability development, there is an opportunity to gain further advantage from its enhancement.

The utility of non-existence

Finally, I’m taking the risk to end this thesis with “nothing”, that is a quotation from the Chinese philosopher, Lao-Zi (老子), to capture the essence of the emergence of meaning from “nothing”:

第十一章：無之以為用 《老子》道徳經
三十辐共一毂，當其無，有車之用。
埏埴以為器，當其無，有器之用。
鑿戶牖以為室，當其無，有室之用。
故有之以為利，無之以為用。

Dao-De Jing: Chapter 11: The Utility of Non-existence [Translation (118)]

“Though thirty spokes may form the wheel, it is the hole within the hub that gives the wheel utility.

It is not the clay the potter throws, which gives the pot its usefulness, but the space within the shape, from which the pot is made.

Without a door, the room cannot be entered, and without windows it is dark.

Such is the utility of non-existence.”

-- Lao-Zi (~500 B.C.)

I would say, in the end,

though many factors may turn risk into being, it is the perception of risk within the SELF that gives safety its meaning.

It is not the views people perceive, that cause the problems, but the gap between these perspectives, in which meanings are taken.

Without opening up our mind, our spirit cannot be flourished, and without seeking shared understanding, our knowledge is meaningless.

To conclude, capability is “nothing” if we don’t put it into use. At most, it provides only a development space for us to ponder. Whether we use it or not, this “nothing” is always within

118 Source: Stan Rosenthal’s Tao Te Ching [or Dao-De Jing], Taoism Information Page, available at URL: http://www.cias.ufl.edu/users/gthursby/taoism/ttcstan3.htm [August 2005]
our SELF. It can’t be seen, but the use of it helps us achieve what we are actually able to do or to be. When capability building and development becomes a purposely chosen evolution process and the property of which is properly understood, then we can see and understand evolution for what it really is: the becoming of something from nothing.
10.2 Directions for future research

By analyzing possible questions that remain, and potential tasks for future research in the area of capability building and assessment, two general aspects are considered a priority:-

(1) how to close the gap between theory and concrete applications at individual and organizational levels; and

(2) the ongoing need to conduct further research so as to ensure what is required to develop is essential, critical and valid.

How to close the gap between theory and concrete applications?

The underlying concepts of well-being (such as being safe), like many issues relating to capability building and safety management are intrinsically complex and vague. “This is largely due to the fact that they involve a plurality of interrelated variables and dimensions but without clear-cut boundaries between them” (Martinette, 2004:2). The same applies to individual and capability building and organizational learning (Senge, 1990). The issues of complexity of capability development have been rarely addressed at the foundation level, and often avoided from an empirical point of view. In lacking of specificity, the associated problems are often perceived in capability analysis as elements of weakness and potential obstacles to the operationalization of the capability approach (see also related discussion in Chapter 5, Section 4).

It is widely believed that complex concepts can be vague because not all complex ideas of concepts can be explained in simple language. It is particularly to be the case, that when a concept is not delineated by clear boundaries, the context would not be precise. Thus complexity and vagueness make things less appealing for practical use. Moreover, at the empirical level, theoretical frameworks characterized by excessive complexity may be difficult to implement or to test. One might therefore base on such arguments critiques of the proposed “Strategic Capability Approach” (SCD). There might be other argument that points to the multidimensional and context-dependent nature of SCD as well. Although this paradox has been duly addressed in the thesis, it might be a worthwhile goal to carry out comparisons at interpersonal or organizational level in a wider context. Otherwise, these elements of ‘weakness’ can seriously preclude the practical application of the approach (Martinette, 2004:2).

The usefulness in addressing a plurality of issues makes capability development a powerful approach. The logic of reasoning provided by plurality includes, for example, safety and risk, criticality and normality, individual and organizational, well-being and functioning,
current and future, etc. within a multiplicity of contexts. This logic of plurality helps interpret the richness regarding what a safe and healthy workplace supposed to be. However, “the great interest in and significant support for Sen’s capability approach by scholars from numerous disciplines is often based on a countered interpretation of the same arguments” (Martinette, 2004:2). Similarly, in human development, it is precisely the rich, strategic and flexible nature of SCD that makes it a viable proposition.

Where is the gap anyway? I would say: they are not the views people perceive, that cause the problems, but the gap between these perspectives, in which meanings are taken. The gap might be somewhere in between perspectives and realities. Or, it could be something separated by the boundary conditions, for example, the framework depicted by the following conceptual model (Chapter 7, Section 7).

**Figure 10-1: Levels of Capability Maturity – pathway to safety excellence**

(Source: Adapted and modified from Humphrey, 1989; Curtis, et al., 1995; Westrum, 1993, 1997; Westrum & Adamski, 1999)

Finally, in acknowledging what makes the capability approach intrinsically complex, one may have to focus on investigating the linkages among the layers of analysis as illustrated by the aforementioned model (Figure 10-1):

- What are the differences and the relationships between capability requirement and each level of functionings?
- What kind of practical advantages and technical difficulties are associated with the decision to focus attention on one particular level or another?
How can human and organizational diversities and the environment influence our achievements, and our possibility to achieve our overall safety mission?

The need to conduct further research to ensure what is developed is essential, critical and valid

On the one hand I’ve tried to show that the aim of the SCD is not to “make things more precise” while things are intrinsically vague, but to “make things more critical, dynamic and flexible” so as to yield leveraging and sustainable results.

In this study, critical capabilities were identified as the key variables of the safety management efficacy scale. The validity of these variables was a crucial factor that affects the reliability of the results. Evidence of content validity was given in Chapter 4 (Section 9) to inform how critical capabilities of safety management were derived. The design and data collection in the early part of my study were in fact a crucial step leading to the development of the SMES.

To ensure consistency of assessment, the questionnaire was developed to measure specifically the relationship between capability maturity and proactiveness based on the same set of indicator variables. To ensure content validity of the survey instrument, the meta-analysis approach served to provide the required evidence. However, capability requirements will change over time. What is critically useful now may become obsolete in the future. A capability inventory list will never be completely summed up and fully represented without any bias of possible change in the future.

Analysis of 32 representative journal articles has been undertaken for my meta-analysis. For future enhancement of the Scale, I would suggest that researchers take up two options. First, based on generally accepted good practices, expert opinions or experience, the developer could potentially modify individual subscales with validated assessment items for each of the evaluation dimensions. Secondly, in light of changes over time, I propose continuing the development process, using the meta-analysis approach. By ongoing reviewing the relevant literature and research findings of other researchers, the developer of the instrument could keep on revising the Scale, and in the end enhancing the assessment criteria to improve the overall validity and to achieve a “rich” comprehension and testing of what is really critical and essential. With further studies in this direction, the evaluation framework and the SMES could eventually become more robust and more accurately encompasses change.

119 Content validity, a category of construct validity, “refers to the degree to which a test measures the content domain it purports to measure” (Sireci, 1998, p. 299).
**Future Research**

Besides closing the gap between theory and applications of the capability development approach, many opportunities also exist for future research. For instance, the methodology presented in this thesis does not provide any detailed analysis of the safety management task components (e.g. in terms of physical demands, specific skill demands, mental workload, and other such factors. A more comprehensive look at these alternatives, including another level of specificity, is a possibility.

Other management factors could also be a major concern in dealing with safety at work. The empirical part of this study was unable to establish a statistical relationship between the clusters of goal-setting capability and the levels of proactiveness in dealing with the critical safety tasks. Some practitioners who have high goal-setting capability are unable to focus their effort on the risk management and control, while some others are capable of doing the right things on a regular basis even their goal-setting capability is not matured enough. The findings of this study suggest that goal-setting capability is an ingredient that affects safety decisions but there are other more influential factors, such as business goals and employers’ risk perceptions may play a more decisive role. Yet, this is an area that future studies are deemed to be required.

Furthermore, some limitations are identified upfront but additional data and analysis would further strengthen the study. For example, similar surveys could be undertaken to look further into company size, types of industry and characteristics of the samples (such as their educational background and experience, gender) and so on. These would produce useful results that most decision makers are interested in such analysis.

The generic model, as illustrated in Fig. 6-1, is a schema of representing the concept of the SCD that the state of well-being is a function of achieved functionings resulting from the conversion of human resources into critical capability sets for the purpose of meeting the identified strategic goals. As the popularity of the SCD approach begins to increase, the SMES methodology could easily be adapted to become a useful evaluation tool for other capability improvements or development processes. However, even extensive studies conducted over a long period of time do not reveal all there is to know about how strategic capabilities are identified and developed for a particular trade or profession. The data used in this thesis were from a typical profession studied over a long, but finite period of time, therefore not all of the safety management capabilities of critical nature were necessarily played out or observed. Further research and application of the SCD concept and the SMES evaluation methodology in other organizations or countries may help promote “Capagogy” that I have coined in this thesis.
With uncertainties, increasing complexity and ever-changing working environments, we shall be asking the same question over and over again: “How can we shape our safety destiny?” Given the significant benefits accrued to SCD, more studies need to be done at organizational level, and more research or consultancy opportunities should be given to operationlize the SCD approach for managing safety at work.
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Appendices

Appendix 1  Selected literature for meta-analysis
Appendix 2  Analysis of individual-referenced domains
Appendix 3  Thematic content for the total literature sample
Appendix 4  Safety Management Efficacy Survey Questionnaire
Appendix 1
Selected Literature for Meta-analysis

Of the 32 selected, seven (7) were published in the journal of Safety Science, six (6) were published in the Journal of Safety Research, four (4) were published in Reliability Engineering & System Safety, two (2) were published in the Journal of Loss Prevention in the Process Industries, and four (6) were published in other journals, such as International Journal of Industrial Ergonomics, the International Journal of Project Management, Journal of Construction Engineering and Management and Journal of Loss Prevention. Of the remainder, (7) were research reports, topical papers or other official safety publications (e.g. published by BSI, IAPA, NOHSC, and Rail Safety & Standards Board). A summary of the analysis is tabled as Appendix 2. The publications selected for this analysis include:

**Safety Science**

**Journal of Safety Research**

**Reliability Engineering & System Safety**
1. Øien, K. (2001)

**International Journal of Industrial Ergonomics**

**International Journal of Project Management**

**Journal of Construction Engineering and Management**

**Journal of Loss Prevention**
Santos-Reyes, J. and Beard, A. N. (2002)

**Journal of Loss Prevention in the Process Industries**
Mitchison, N. and Papadakis, G. (1999)

**Facility**
Research Reports / Topical Papers / Other Publications


## Appendix 2

### Analysis of individual-referenced domains

**Selected Literature for Meta-analysis**

<table>
<thead>
<tr>
<th>Strategic Issues</th>
<th>Reference</th>
<th>Number of times referenced (X = 1 count)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32</td>
<td></td>
</tr>
<tr>
<td>Risk-based policy, risk-informed safety goals &amp; management strategies, transparent management approach, goal-setting with clear safety objectives, probabilistic decision making</td>
<td>X</td>
<td>X X X X X 5</td>
</tr>
<tr>
<td>Organizational learning for enhancing safety culture</td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>Application of safety management principles</td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>Application of safety engineering principles for risk control (engineering controls)</td>
<td>X X X</td>
<td>3</td>
</tr>
<tr>
<td>Empowerment</td>
<td>X X</td>
<td>X 3</td>
</tr>
<tr>
<td>Management of change (e.g. Culture change or management of organizational change)</td>
<td>X X X</td>
<td>4</td>
</tr>
<tr>
<td>Institutional design</td>
<td>x</td>
<td>1</td>
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<tr>
<td>Management commitment &amp; involvement</td>
<td>X X X</td>
<td>12</td>
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<tr>
<td>Management attitude</td>
<td>X X</td>
<td>2</td>
</tr>
<tr>
<td>Management priorities (e.g. high safety priority)</td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>Availability of resources for safety (e.g. resources required to maintain critical functions)</td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>Leadership and administration in OSH</td>
<td>X X</td>
<td>4</td>
</tr>
<tr>
<td>Safety policies</td>
<td>X X X</td>
<td>13</td>
</tr>
<tr>
<td>Safety goals, minimum functional requirements, and standards development</td>
<td>X X X</td>
<td>4</td>
</tr>
<tr>
<td>Planning, coordination, organization, control</td>
<td>X X X X</td>
<td>9</td>
</tr>
<tr>
<td>Organizational and management support to improve safety climate</td>
<td>X X</td>
<td>4</td>
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<td>Reference &gt;</td>
<td>Number of times referenced ((X = 1) count)</td>
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<td></td>
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<tr>
<td>Hiring and placement practices</td>
<td>X    X</td>
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<tr>
<td>Purchase management</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Design for safety and design control</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>Effectiveness of systems, programmes and processes to manage OSH</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Safety management review or status review (e.g. identification of weaknesses for improvement)</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>Safety awareness (organizational and situational)</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>Participation or support – staff / worker</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>Participation, support, commitment – supervisor / line management</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Reward / incentive system</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Development and adaptation of best practice, including benchmarking</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Claim management</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Certification of OHSMS</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Organizational Factors</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Clarification of roles, responsibilities and accountability</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>Dealing with specific hazards and work organization issues</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Implementation strategy (e.g. Plan-do-check-improve or PDCA)</td>
<td>X    X</td>
<td></td>
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<tr>
<td>TQM methodology</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Internal motivation for implementation</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>External push and pull factors for implementation</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Risk assessment and analysis (e.g. functional and structural, gap analysis, job analysis, consequence analysis, etc)</td>
<td>X    X</td>
<td></td>
</tr>
<tr>
<td>Identification of constraints and barriers</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Documentation</td>
<td>X    X</td>
<td></td>
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<tr>
<td>Management of information (e.g. Documentation, data collection and analysis/record keeping, transparency of OSH information, provision of safety information, handling of safety records, etc)</td>
<td>X    X</td>
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<tr>
<td>Reference &gt;</td>
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<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32</td>
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</tr>
<tr>
<td>Integration with environment, quality and other mainstream management functions</td>
<td>X X X</td>
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<tr>
<td>Operational Activities</td>
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<td></td>
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<tr>
<td>Planned maintenance &amp; inspection</td>
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<tr>
<td>Standard of Housekeeping</td>
<td>X</td>
<td></td>
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<tr>
<td>Standard &amp; availability of equipment necessary to perform the job safely</td>
<td>X</td>
<td></td>
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<tr>
<td>Regulatory management - compliance with standards and regulations. Checking of non-compliance &amp; adherence to site rules (e.g. low tolerance of rule violations, control on non-conformance)</td>
<td>X X X X X</td>
<td></td>
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<tr>
<td>Failure mode analysis</td>
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<tr>
<td>Safety Culture indicators – activity indicators</td>
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<tr>
<td>Shared values, norms, care and concern</td>
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<tr>
<td>Consultation (e.g. safety representatives)</td>
<td>X X X X</td>
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<tr>
<td>Appointing trained safety representative on site</td>
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<tr>
<td>Activities on safety culture involving regulators &amp; contractors</td>
<td>X</td>
<td></td>
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<tr>
<td>Systematic analysis of incidents to determine human factors and lessons learned</td>
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<tr>
<td>Culture Training activities (e.g. management talk on safety)</td>
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<td>Surveys to determine employee's attitudes</td>
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<tr>
<td>Adequacy of resources allocated to promote safety</td>
<td>X X X X</td>
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<tr>
<td>Self-regulation, self-managed approach</td>
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<tr>
<td>Employee perception regarding the level of risk (e.g. high mastery and high risk awareness)</td>
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<td>Safety Culture indicators – weakening safety culture</td>
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<tr>
<td>Blame, organizational politics and cover-up</td>
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<tr>
<td>Incidents not analyzed in-depth and lessons not learned</td>
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<tr>
<td>Increase number of violations</td>
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<tr>
<td>Failure to deal with findings of external safety reviews</td>
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<tr>
<td>Information difficulties (e.g. critical errors and incidents remain latent, or are misunderstood)</td>
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<tr>
<td>Problems with manapower and/or training</td>
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<tr>
<td>Work pressure, fatigue, time pressure</td>
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<tr>
<td>Human Factors</td>
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<tr>
<td>Employee safety attitudes</td>
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<tr>
<td>Implementing safety behavior and human factors intervention, and measuring behavior</td>
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<td>Competence of management and workers for OSH work and development work</td>
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<td>Management capacity</td>
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<td>Continual reflection upon practice for improvement</td>
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<td>Self-reporting behavior</td>
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<td>Confidential reporting</td>
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<td>Working Environment</td>
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<td>Technological complexity</td>
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<td>Conducting studies of environmental factors or exposures</td>
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<td>Effective safety training and personnel development</td>
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<td>In-house regulations, rules, procedures and guidelines (realistic and flexible norms and rules, whether safety procedures for critical works have been identified)</td>
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<td>Inspection programme</td>
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<td>Accident/incident investigation &amp; analysis</td>
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<td>Management of sub-contractors</td>
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<tr>
<td>Effectiveness of Safety &amp; Health Committees or group meetings</td>
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<td>Risk management &amp; hazard control (e.g. statement of principles for hazard prevention and control, risk management strategies, developing methods for identifying hazards and evaluating loss potentials, risk identification, analysis, risk mitigation, risk control, ALARP concept, regulating risk acceptability, corrective and preventive actions, risk communication, etc)</td>
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<td>Error management program</td>
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<tr>
<td>Review / Audit</td>
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<td>A sound system of safety review / audit or evaluation strategies</td>
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<td>Effectiveness and credibility of safety officers</td>
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<td>Risk communication</td>
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<td>Key drivers of good OSH</td>
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<td>Reducing costs associated with OSH</td>
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<td>Safety Performance Indicators (traditional)</td>
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<td>Lost time injury frequency rate (LTIFR)</td>
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<td>First aid</td>
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<td>Medical treatment injury rate</td>
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<td>Cost of compensable injuries</td>
<td>X</td>
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<tr>
<td>Recurrence of incidents</td>
<td>X</td>
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<tr>
<td>Lost time injuries to contractor employees/sub-contractors</td>
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<td>Medical time injuries to contractors employees/sub-contractors</td>
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<td>Non-injury incidents (near-miss) investigated for both contractors employees and sub-contractors</td>
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<td>Positive Performance indicators</td>
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<td>Number of JSAs conducted</td>
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<tr>
<td>Percentage of injuries incurred for major hazards</td>
<td>X</td>
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<tr>
<td>Percentage of sub-standard conditions identified and corrected as a result of safety audits</td>
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<td>Reaction time to deal with issues that are raised</td>
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<tr>
<td>Compiling and interpreting data for corrective actions (e.g. accident data collection, use of statistical techniques)</td>
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### Appendix 3

#### Thematic content for the total literature sample (N=32)

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<thead>
<tr>
<th>Contributing Factors Cited in Literature</th>
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<tr>
<td>1. Effective safety training and personnel development</td>
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<td>2. Effective Communication &amp; feedback (e.g. self-reporting, integrated safety reporting, communicating recommended control procedures and programs to decision makers and workers, reporting of near miss occurrences, internal &amp; external communication, etc)</td>
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<tr>
<td>3. Risk management &amp; hazard control (e.g. statement of principles for hazard prevention and control, risk management strategies, developing methods for identifying hazards and evaluating loss potentials, risk assessment, identification, analysis, risk mitigation, risk control, ALARP concept, regulating risk acceptability, corrective and preventive actions, etc)</td>
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<tr>
<td>4. Safety policies and goal-setting (e.g. setting safety objectives, functional requirements, standards development, performance criteria)</td>
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<tr>
<td>5. Management commitment &amp; involvement (e.g. management support, senior management commitment, review of safety performance by management, safety as part of staff appraisal criterion)</td>
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<tr>
<td>6. Risk assessment and analysis (e.g. functional and structural, gap analysis, job analysis, consequence analysis, etc)</td>
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<tr>
<td>7. Performance-based strategy: performance management; program; performance monitoring &amp; evaluation; effective use of proactive safety performance indicators, performance assessment program / strategies; safety performance feedback, measures, monitoring, etc</td>
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<tr>
<td>8. In-house regulations, rules, procedures and guidelines (realistic and flexible norms and rules, whether safety procedures for critical works have been identified)</td>
<td>11</td>
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<tr>
<td>9. A sound system of safety review / audit or evaluation strategies</td>
<td>10</td>
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<tr>
<td>10. Planning, coordination, organization, control</td>
<td>9</td>
</tr>
<tr>
<td>11. Clarification of roles, responsibilities and accountability</td>
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<tr>
<td>12. Regulatory management - compliance with standards and regulations. Checking of non-compliance &amp; adherence to site rules (e.g. low tolerance of rule violations, control on non-conformance)</td>
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<tr>
<td>13. Effectiveness of systems, programs and processes to manage OSH</td>
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<tr>
<td>14. Participation or support – staff / worker</td>
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<tr>
<td>15. Management of information (e.g. Documentation, data collection and analysis/record keeping, transparency of OSH information, provision of safety information, handling of safety records, etc)</td>
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<td>16. Planned maintenance &amp; inspection</td>
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<td>17. Effectiveness of Safety &amp; Health Committees or group meetings</td>
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<td>18. Competence of management and workers for OSH work and development work</td>
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<td>19. Environmental conditions (safety working conditions)</td>
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<td>20. Personal protection programme (e.g. PPE, Assessment of the availability and standard of PPE)</td>
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<tr>
<td>21. Risk-based policy, risk-informed safety goals &amp; management strategies, transparent management approach, goal-setting with clear safety objectives, probabilistic decision making</td>
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<tr>
<td>22. Design for safety, design planning and control</td>
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<tr>
<td>23. Management of change (e.g. Culture change or management of organizational change)</td>
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<tr>
<td>24. Safety goals, minimum functional requirements, and standards development</td>
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<tr>
<td>25. Organizational and management support to improve safety climate</td>
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<td>26. Hiring and placement practices</td>
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<td>27. Purchase management</td>
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<td>28. Reward / incentive system</td>
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<td>29. Culture Training activities (e.g. management talk on safety)</td>
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<td>30. Implementing safety behavior and human factors intervention, and measuring behavior</td>
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<td>31. Inspection programme</td>
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<td>Contributing factors cited in literature</td>
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<td>32. Accident/incident investigation &amp; analysis</td>
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<td>33. Promotion of safety and health</td>
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<td>34. Compiling and interpreting data for corrective actions (e.g. accident data collection, use of statistical techniques)</td>
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<td>35. Leadership and administration in OSH</td>
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<td>36. Application of safety engineering principles for risk control (engineering controls)</td>
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<td>37. Empowerment</td>
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<tr>
<td>38. Development and adaptation of best practice, including benchmarking</td>
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<tr>
<td>39. Implementation strategy (e.g. Plan-do-check-improve or PDCA)</td>
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<td>40. TQM methodology</td>
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<td>41. Internal motivation for implementation</td>
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<tr>
<td>42. Integration with environment, quality and other mainstream management functions</td>
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<td>43. Standard of Housekeeping</td>
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<td>44. Consultation (e.g. safety representatives)</td>
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<td>45. Adequacy of resources allocated to promote safety</td>
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<td>46. Self-regulation, self-managed approach</td>
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<td>47. Employee perception regarding the level of risk (e.g. high mastery and high risk awareness)</td>
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<td>48. Employee safety attitudes</td>
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<td>49. Continual reflection upon practice for improvement</td>
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<td>50. Emergency preparedness &amp; response programme</td>
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<td>51. Management of sub-contractors</td>
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<tr>
<td>52. Management attitude</td>
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<td>53. Availability of resources for safety (e.g. resources required to maintain critical functions)</td>
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<td>54. Safety management review or status review (e.g. identification of weaknesses for improvement)</td>
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<td>55. Participation, support, commitment – supervisor / line management</td>
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<td>56. Documentation</td>
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<td>57. Shared values, norms, care and concern</td>
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<td>58. Appointing trained safety representative on site</td>
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<td>59. Activities on safety culture involving regulators &amp; contractors</td>
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<tr>
<td>60. Systematic analysis of incidents to determine human factors and lessons learned</td>
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<td>61. Work pressure, fatigue, time pressure</td>
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<tr>
<td>62. Management capacity</td>
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<td>63. Safety organization</td>
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<td>64. Process/project control</td>
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<td>65. Health control, screening or protection programme</td>
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<td>66. Reducing costs associated with OSH</td>
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<td>67. First aid</td>
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<td>68. Organizational learning for enhancing safety culture</td>
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<td>69. Application of safety management principles</td>
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<td>70. Institutional design</td>
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<td>71. Management priorities (e.g. high safety priority)</td>
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<td>72. Safety awareness (organizational and situational)</td>
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<td>73. Claim management</td>
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<td>74. Certification of OHSMS</td>
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<td>75. Dealing with specific hazards and work organization issues</td>
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<td>76. External push and pull factors for implementation</td>
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<td>77. Identification of constraints and barriers</td>
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<td>78. Standard &amp; availability of equipment necessary to perform the job safely</td>
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<td>79. Failure mode analysis</td>
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<td>80. Operation / work control</td>
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<td>81. Blame, organizational politics and cover-up</td>
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<td>82. Incidents not analyzed in-depth and lessons not learned</td>
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<td>83. Increase number of violations</td>
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<td>84. Failure to deal with findings of external safety reviews</td>
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<td>85. Information difficulties (e.g. critical errors and incidents remain latent, or are misunderstood)</td>
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<td>88. Technological complexity</td>
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<td>91. Error management program</td>
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<td>96. Lost time injury frequency rate (LTIFR)</td>
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<td>97. Medical treatment injury rate</td>
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<td>98. Cost of compensable injuries</td>
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<td>102. Non-injury incidents (near-miss) investigated for both contractors employees and sub-contractors</td>
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<td>103. Number of JSAs conducted</td>
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<td>104. Percentage of injuries incurred for major hazards</td>
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<td>105. Percentage of sub-standard conditions identified and corrected as a results of safety audits</td>
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<td>106. Reaction time to deal with issues that are raised</td>
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### APPENDIX 4 - SAFETY MANAGEMENT EFFICACY (SME) SURVEY

Have you ever involved yourself as a safety practitioner?  **Yes □  No □**  For how long? [ ] (No. of years)

My present position is: (please tick with a check mark ‘✓’)

- Safety Manager
- Safety Auditor
- Safety Officer
- Safety Supervisor
- Safety Consultant
- Others

I have been in this capacity since  [ ] [ ] [ ] (MM/YY)

The following questions ask you to estimate your own ability. On a scale of 1 to 10, circle the number to indicate how confident you can perform each of the following safety tasks in your organization? However, please select option “0” if you did not know what the statement means. In response to “How often the task has been done?”, please indicate your response using the scale on the left of the SMEs. **Thank you!**

**Task Frequency:**  D = Daily,  W = Weekly,  M = Monthly, and  Y = Yearly

<table>
<thead>
<tr>
<th>How often the task has been done?</th>
<th>I am confident in my ability to:</th>
<th>Not at all</th>
<th>Very confident</th>
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<tbody>
<tr>
<td>D □ W □ M □ Y □</td>
<td>formulate and review safety policy in accordance with what is required by law</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>determine safety needs and make changes to safety goals if necessary</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>secure senior management commitment and support</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
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<td>D □ W □ M □ Y □</td>
<td>integrate risk management into strategic decision making</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>review and evaluate safety performance</td>
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<td>D □ W □ M □ Y □</td>
<td>define a risk management framework and implement a process for carrying out risk assessment</td>
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<td>D □ W □ M □ Y □</td>
<td>identify hazards in the workplace</td>
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<td>D □ W □ M □ Y □</td>
<td>evaluate risks in response to hazards identified</td>
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<td>D □ W □ M □ Y □</td>
<td>set acceptable levels of risk</td>
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<td>D □ W □ M □ Y □</td>
<td>identify suitable responses to risk and implement appropriate control measures</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>review assessment of hazard and effectiveness of control methods</td>
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<td>D □ W □ M □ Y □</td>
<td>identify safety training needs of the organization</td>
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<td>D □ W □ M □ Y □</td>
<td>plan and implement the training of staff involved in risk assessments</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>provide in-house training in safety/risk management for management staff</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>Mainstream safety at work for employees by providing appropriate competence training</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>review training strategy on a regular basis</td>
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<td>D □ W □ M □ Y □</td>
<td>establish a communication process for risk communication</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
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<td>D □ W □ M □ Y □</td>
<td>communicate information about work-related hazards to all relevant parties</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>promulgate instructions and guidance relating to legislative requirements</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>organize and promulgate safety information using appropriate information systems</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>prepare safety manuals and propose in-house safety rules</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>facilitate safety committee meetings</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>develop and implement safety plans</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>check compliance with legislative requirements</td>
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<td>D □ W □ M □ Y □</td>
<td>conduct routine safety inspection</td>
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<td>D □ W □ M □ Y □</td>
<td>conduct induction training for new employee</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>conduct accident investigation &amp; incident analysis</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>reinforce in-house safety rules</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>prepare accident and incident reports</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>compile and analyse safety statistics</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>resolve safety problems reported by subordinates</td>
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<tr>
<td>D □ W □ M □ Y □</td>
<td>establish emergency procedures for potential hazards or disastrous happenings</td>
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