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EFFECTS OF OCCUPATIONAL HEALTH AND SAFETY ASSESSMENT SERIES STANDARD AND ORGANIZATIONAL LEARNING ON CORE COMPETENCIES BUILDING.

Case: Bodycote Lämpökäsittely Oy.

Master´s Thesis in
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LIST OF ABBREVIATIONS

AS 9100B	- Aerospace Sector Standard certification
EHSQ	- Environment, Health, Safety and Quality
FINAS	- Finnish Accreditation Service
HFE	- Human Factor and Ergonomics
HIP	- Hot Isostatic Pressing
ILO-OSH	- International Labor Standards on Occupational Safety and Health
ISO	- International Standards Organization
IWH	- Canadian Institute for Work & Health
LTI rate	- Lost Time Injury rate frequency
MSD	- Minimum Standard Deviation
OH&S	- Occupational Health and safety
OHSAS	- Occupational Health & Safety Assessment Series
OHSMS	- Occupational Health and Safety Management System
PDCA	- Plan, Do, Check, Act
PPE	- Personal Protective Equipment
SCB	- Safety Citizenship Behavior
SECI	- Socialization, Externalization, Combination and Internalization
SHE	- Safety, Health and Environment
TQM	- Total Quality Management

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ABSTRACT:

This thesis investigates the effects of an occupational health and safety management system and organizational learning to core competencies building; to be precise, OHSAS 18001:2007 and knowledge creation in a typical industrial setup. Theories employed are OHSAS 18001:2007 and the five phase model of organizational knowledge creation process. - *Knowledge spiral*. Essentially, it employs the Serpentine module of Evolute research tool for enquiry, data collection and analysis of the levels of safety culture and knowledge interaction. Interviews as well as observations to ascertain the extent of applicability of these theories are also presented. Herein suggestions and proposals are given for factors that need improvement through management initiative and direction.

The idea is boosting capacity through sustainable employee wellbeing and core competency building programs; - *the human factor*. In this way, the effects of institutionalizing a vibrant policy as proposed in an industrial environment to productivity of the company can be realized. The writer hopes that by implementing these proposals of the study, there would ultimately be a breakthrough in the dynamic capability of the firm.

The case study is a company that has been in existence for almost a century and currently the global leader in provision of thermal processes supplies.

KEYWORDS: occupational health, safety management system, safety culture, organizational learning, dynamic capability, knowledge creation and core competences building.

TERMS AND DEFINITIONS

The following terms are defined as used in the OHSAS document and throughout the scope where it is applicable.

Acceptable risk: A satisfactory level of risk that is tolerable by the organization. It is in relation to the national obligatory Occupational Health and Safety (OH&S) policy.

Audit: In reference to the OHSAS standard, audit is an organized and a self-reliant documented process for acquiring "audit evidence" and assessing if its "audit criteria" are met.

Continual improvement: An ongoing process of constantly improving the OH&S management system with the objective of overall OH&S performance contained in the organizations OH&S policy.

Corrective action: It can be defined as the process of determining and eradicating the cause of an exposed nonconformity or any other unacceptable situation in the company in regards to its *occupational health and safety.*

Document: written or printed information and the media in which it is contained.

Hazard: A possible source/condition that has the possibility of causing injury or threat to health.

Hazard identification: A mechanism or process instituted to identify the existence and tendency of hazard.

Ill health: An inferior mental or physical health condition caused by a work related activity.

Incident: An emergency or event (at the work place or because of the organizations actions) which caused injury, fatality or ill health. This involves near-miss or close call situations.

Interested party: People within or without the organization who are interested or concerned by the OH&S performance.

Nonconformity: A deviation from the applicable requirement, practices or legal requirements.

Occupational Health and safety (OH&S): *The conditions and factors that affect or could affect the health and safety of employees or other workers (including temporary workers and contractor personnel), visitors, or any other person in the workplace.*

OH&S management system: An organizations management system used to establish and control its OH&S policies and objectives. This constitutes its practices, procedures, processes and resources.

OH&S objective: A target or goal (consistent with the policy) of an organization in relation to its OH&S performance.

OH&S performance: A quantifiable outcome of organizations OH&S risks in terms of its control, policy or objectives.

OH&S policy: Management laid down principles and directions for the performance of an OH&S. (ISO 14001:2004).

Risk: The probability of the occurrence of injury or ill health.

Risk assessment: This is the process defined by the OHSAS standard for identifying hazards or risks.

Workplace: The location (factory or facility) under the jurisdiction of the organization.

(OHSAS 18001:, 2007, ss. 2-5)

1. INTRODUCTION

A great wave of change flows, and as it rolls, it carries with it to the shores of industry the need to learn and more so to learn at a faster rate than previously. One cardinal fact of this generation is the momentous impact of knowledge creation and organizational learning in industry. Due to fast technological innovations and rapidly changing market trends, organizations thrive and stay in business amidst a competitive atmosphere only when it learns. To do so, awareness building and experience sharing amongst employees becomes critical. Thus, the organization is empowered by the never ending quest for improvement due to the constant and dynamic nature of knowledge creation linked to technological innovations and scientific discoveries. Essentially, it boils down to the human perspective. More importantly, this need be complementary to employee health and safety. Mostly, health, safety and human factor issues in industry are dealt with by the humanities. The writer has held several engineering positions on the factory floor for almost a decade in the case company; from line operation of furnaces, through equipment maintenance to production planning. Obviously, he sees the promotion of these human factors core to the wellbeing of employees and progress of the company mutually related.

The purpose of this study is to evaluate the promotion of company information disbursement culture in relation to safety culture of an organization accredited with an *Occupational Health and Safety Assessment Series standard*: - **OHSAS 18001:2007** in promoting the human factor. Furthermore, it suggests internal methods for competences building in the said company: - Bodycote Lämpökäsitelly Oy.

1.1. Background and objectives of this study

There has been a lot of talk in emphasizing priority of the human resources as a prerequisite for production enhancement. Invariably, more attention and commitment seems to be given to equipment and machines than enabling the capability, knowledge empowerment and

health of the worker whose ingenuity obviously turns equipment and machines into the intended and desired purposes. This paper looks at the human perspective: - His/her health, safe work environment, and know-how.

The benefits of computers, robots and automation in industry is undoubtedly numerous. Machines and equipment provides a competitive edge, improved quality, increased productivity and therefore provide significant savings and reduction in production time. Undoubtedly, these systems yield their maximum output only when used effectively and appropriately. However, the concept of a learning organization can also be expensive. The question is, is the notion necessary for the survival and progress of subcontracting energy firms especially for those that have well defined goals and tasks? As the aged population in Europe increases and with people over 60 expected to increase to 32% by 2050 from the current 20%, (Chive & Manthorpe, 2009, s. 46). Evidently, there is constant replacement by newer and younger employees. To avoid a potential generational gap, the wellbeing of employees in terms of health and safe conditions of work coupled to his competence cannot be compromised. An issue that is foremost on the minds of people obsessed with *occupational health and safety* is instituting and continuously improving steps to prevent fatalities or adverse health issues.

Currently, there are a number of legislations for occupational health and safety measures in industry. It is also well known that the process of acquiring OHSAS due to its audits and reviews can be demanding. Even after acquiring OHSAS, it is known that these reviews and audits may not be enough to grant an organization with the guarantee that its achievement not only meet but would continue to meet the required policy and legal obligations. For *Occupational, Health and Safety* (OH&S) policy to be effective, it needs to be conducted by a meticulous management system that is integrated within the organization. In spite of these difficulties, most organizations accredited with OHSAS believe the benefits far outweigh the arduous processes and acquisition costs. The research is based on how workers perceive the indicators of organizational learning and safety ontology at the work place. To enhance the human potential in industry, his/her wellbeing

is vital to development in any field. For this to be possible, there need to exist in the firm a safety culture which needs to be part of the overall organizational culture (Cooper, 1998).

1.2. Scope and limitations

The scope of this thesis is to investigate the effects of an accredited OHSAS Standard to the wellbeing of workforce and the level the case company encourages organizational learning. In other words, knowledge creation linked to employee health and safety to productivity by core competences building. The conceptual framework of this paper evolved and is established based on relevant theories and literature on factors that drive the implementation of OHSAS and learning. Hence a number of factors are determined which are: - Safety culture, the relevant standards of occupational health, knowledge creation, knowledge management, and organizational learning. Locations of the four thermal processing plants of Bodycote in Finland are: - Vantaa, Tampere, Pieksamaki and Vaasa. Twenty workers were targeted for the research. Out of this number, 16 responded; that is 80% response rate.

- **Limitations**

Although various engineering industries have many interesting factors for consideration in relation to OH&S and knowledge management, this research was confined to only the heat treatment circles. Suggestions however are applicable to all industrial setups. Enhancement methods are also restricted to only domestic organizational circumstances. Focus was more on methods of competences building such as developing current knowledge assets and by socialization. Factors like hiring expect or even outsourcing and subcontracting were eliminated. Another constraint is that due to the extensive nature of the questionnaire, the targeted group was reduced: - a limitation on the probability sampling. However, focus was on a cross section of the entire work force. Namely, 4 managers in the order, 3 plant managers, and the maintenance/safety manager. The others are 3 safety delegates/foremen,

2 engineers, an office secretary and 6 factory floor workers. This target provided a fair and general representation of employees across board. The research was conducted during the summer of 2015.

1.3. Research questions

Questions used for the research are embedded in the second (2.0) version of the Serpentine module of the Evolute LLC system. Evolute is a resourceful web-based tool for evaluating various human competences. The Serpentine 2.0 module contains 51 questions which are derived from 17 concepts ranging from safety environment and training through safety culture to openness of organizations to new ideas as in knowledge creation. Its evaluation tackles the broad spectrum of safety and knowledge creation. Evolute does this by employing an intelligent based fuzzy logic that analyzes the exact condition of *Environment, Health, Safety and Quality* (EHSQ) of the work place as enshrined in OHSAS guidelines for accreditation. Data for this research is collected by creating alias accounts for each participant in the Evolute research tool. Analysis is by pie charts and bar charts automatically generated with visible statistical variables of the generated graphs. From the pie charts, the current state of affairs (reality) can be analyzed as against the desired goal (target).

Interviews with the plant manager at Vaasa/Tampere plants, and the Safety, Health and Environment (SHE) manager are also presented as to the merits and demerits of OHSAS implementation.

Hypothesis:
The culture of a learning organization and implementation of OHSAS improves productivity.

Data collection and search methods

A search was conducted for publications that researched into the effects of OHSAS and organizational learning on competency building. The databases used are, *Science Direct*, *Wiley Inter Science, Journal of Economic and Social Research, Journal of Applied Psychology, Emerald Insight and International Journal of Occupational Safety and Ergonomics* amongst others. The lists of references of compatible literature were as well checked to see if they met the eligibility criteria for any previous research exactly into this topic but none met the review inclusion criteria.

1.4. Structure of the study

This paper is structured in the following 5 major chapters.

Chapter 1: Introduces the entire research of the - Effects of OHSAS and organizational learning on competences building in engineering firms. Contained in it is the background with objectives of the study while considering the scope and limitations. It also looks at the research questions and the tools employed to undertake this study. It as well includes the general view to more specific target of subsequent chapters of the topic under investigation.

Chapter 2: The main ingredient in this chapter is the literature review and the theoretical framework. It undertakes the concept of safety standards of occupational health as employed in the OHSAS 18001-2007 framework and extensive insight by incorporating Ikujiro Nonaka and Hirotaka Takeuch's four different modes of knowledge conversion. Namely, *Socialization, Externalization, Combination* and *Internalization* as part of the learning theory to access the level of interaction that promotes tacit and explicit knowledge. Both of which are prime virtues of competence building in an organization. These theories are studied as in its applicability to the problem at stake.

Chapter 3: In this chapter, the research methods employed for the study is explained. Steps, research approach and the research processes are discussed. Furthermore, it focuses on the Serpentine module of the Evolute research system as the tool employed in data collection and data analysis. Here, the case company is introduced with scrutiny into its level of safety culture and internal study culture amidst hazardous conditions associated to heat treatment processes.

Chapter 4: Chapter 4 analyzes and interprets the results of the studies. Data received and enquiries of in-depth meetings are evaluated and finally, empirical results of the research are disclosed here. These findings in relation to theoretical solutions are also presented as proposals to the case company. Hitherto the criticism, effects, benefits and validity of the thesis is discussed.

Chapter 5: In this chapter, a summary of findings are given which presents a conclusion in relation to the study. Appropriate recommendations based on the research are also given with future research possibilities.

1.5. Research approach

This research is designed in a qualitative as well as deductive research structure. Theories of a structured vigorous health and safety standard in relation to corporation's internal information flow are outlined. The procedure of enquiry –research design/methods; adopted is based on the nature of this specific issue at hand. Also, as an action research, it paves way for a more interactive analysis of the case at stake that promotes theoretical ideas and practical implementation of standards and systems.

Although it is customarily known that in qualitative research, the researcher's aim is usually to broaden and generalize known theories and not just to establish the rate that a phenomenon materializes in a population (Hyde, 2000), however, this particular approach employed seeks to accomplish just that.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This chapter tackles the two main concepts used in the research. Being

a) The theory of *Occupational Health and Safety Assessment Series* (OHSAS 18001:, 2007) Standard.

b) Knowledge creation and learning in organizations.

2.1. The OHSAS 18001:2007 Standard

Generally, it is known that a poor health and safety record of any organization can seriously impair the reputation and image of the organization particularly with its customers and even investors. In today's industry, it is needful to mention that one must endeavor to pinpoint workplace hazards and then strive to its elimination (Eichler & Oppenheim , 2015, ss. 160-163). OHSAS 18001:2007 standard was formed jointly by a number of world leading standards institutions, certification authorities and consultants specialized in the field. The standard was first published in 1999 with compatibility to the International Standards Organization (ISO) 14001 and ISO 9001 management system standards with the aim of achieving an integration of the three systems (Zeng;Shi;& Lou, 2007).

The current version was established in July 2007 to repudiate OHSAS 18001:1999; aiming to address the OH&S instead of product safety. By this regulation, a framework of continuous improvement of the management of OH&S was established which complies with legislation that applies to the organizations activities and identified hazards. In this paper, the correspondence between OHSAS 18001:2007, ISO 14001:2004 (Environmental) and ISO 9001:2000 (Quality) is also evaluated in relation to OHSAS implementation. OHSAS 18001 guidelines for the accreditation was developed to be compatible with the environment and quality management systems standard. Both of which Bodycote had before OHSAS accreditation in 2007. These are designed to promote the facilitation and integration of quality, environmental and occupational health and safety management systems by organizations that wish to be accredited (OHSAS 18001:, 2007, s. introduction).

2.1.1. OHSAS Accreditation

An OHSAS accreditation is therefore an indication of the importance the certified organization places on health and safety and the assurance that appropriate measures exists to protect workers and interested persons. Stakeholders are subsequently assured of the existence of a system of best practice and that health and safety are continuously improved. Several occupational risk and health factors like the structure of the organization, safety culture, communication, training, understandable instructions, codes, standards and leadership responsibility have been suggested to have influence on the general safety at the workplace (Koukoulaki, 2010).

According to the OHSAS document, any organization that wishes to be accredited and become OHSAS 18001:2007 standard compliant can do so by the following steps:

    a. Design, establish, manage and constantly improve on an OH&S policy. This can be achieved by planning and instituting an *occupational health and safety management system* (OHSMS) to reduce to the barest minimum or possibly eliminate any hazardous conditions or risk to workers as well as to any persons subjected to activities of the said organization;

    b. Instituting a continuous system of maintaining and improving an OHSMS;

    c. Sticking to its OHS policy is also mandatory;

    d. That this OH&S policy need be demonstrated to others;

    e. That its certification or registration to OHSAS would be by the auspices of an external certifying administration and;

    f. A declaration of conformance to the specification of the OHSAS standard by building a self-determination and self-declaration status:

    (Tsai & Chou, 2009).

It is imperative for any organization accredited with a *health and safety management standard* to have this system assimilated to the entire management system of the organization. The purpose is to achieve maximum impact throughout the organization as it becomes integrated and embodied in top management deliberations and consideration.

- Objectives, programs and implementation

The organization's OH&S objectives are to be measureable and documented in consistence with OH&S policy. These objectives also take into account any other exclusive organizational legal requirements. Other concerns such as the operational, financial and technological requirements are to be considered. The OH&S programs to be instituted, enforced and maintained shall include but not limited to:

a. Designation of authority at various levels of the organization.

b. Designed time-frame for the achievement of these aspirations.

c. Ultimate responsibility for the OH&S management shall be placed on the top management. These include the assurance of the availability of the necessary resources to keep OH&S in place.

d. Effective communication and documentation of the defined roles and allocated responsibility while being accountable to the OH&S policy.

A top management team member appointed to oversee shall also ensure constant submission to top management reports on the performance of the OH&S management system. This is to enable management review and improve on the system.

- Training and Competence building

The organization ensures that their staffs are well trained in the handling of their tasks in regards to its OH&S policy. Training shall include – improvement of personal safety awareness, knowledge on emergency responses and procedures, evacuation steps in the event of danger. It is most helpful as the tripartite structure of safety being government, labor and employers as seen usually within the European Union would possibly lead to much more improvement in this regard (Leamon, 2001).

2.1.2. OH&S management system model

The OHSAS management system model in figure 1 is based on the Plan Do Check Act (PDCA) management systematic method to control and continuously improve processes popularly known as the Deming's cycle or wheel in figure 2. In the same way, a continuous improvement plan is incorporated in the health and safety of workers and interested persons. When an organization receives OHSAS certification, the certifying body's client manager continues to pay regular visits to the organization to ensure that the system does not only remain compliant but that it improves continuously.
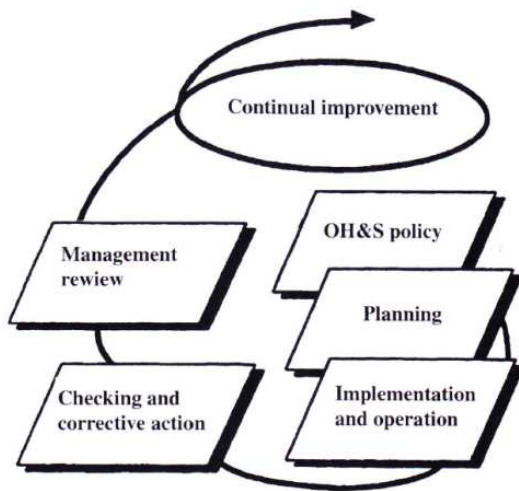
Figure 1. Management model in OHSAS Structure: Adapted from (OHSAS 18001:, 2007).
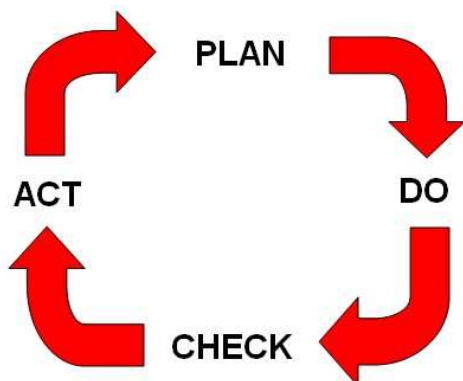
Figure 2. Deming's PDCA cycle. Adapted from (Carpenter_Group, 2015)

An Integrated management system combines quality management and environmental management systems. Thereby a comprehensive consolidation in the process/product quality and environmental management systems is ensured to work alongside the health and safety management systems (Nenadal & Rizeni, 1998). This accession is in conformity with PDCA total quality management (TQM) process as explained below.

- Plan: The objectives and processes needed to deliver the necessary conditions in accordance to the organizations OH&S policy are established.

- Do: A defined process to the solution is implemented.

- Check: Measuring and monitoring the solution processes by the OH&S guideline, purpose, legal and other requirements. Results are then accordingly reported.

- Act: Actions are taken to continuously improve OH&S performance.

(Janakiraman & Gopal , 2006, ss. 104-105), (Salls, 2002, s. 7).

The OHSAS standard works by complying with the intended organizations country's applicable statutory legal requirements and other relevant requirements to which the organization subscribes to. The goal is to prevent injury and ill health and also to continuously improve the said conditions. Although the standard has many benefits, it is however not designed to address issues such as employee conditions of service, safety of products, pilferage and prevention of damage. These other management systems, example product/service quality, security or financial management are generally not contained in this OH&S standard. However, there is the possibility for the organization to adapt its existing management system to conform to the requirements of the OHSAS 18001 Standard. It is important to state however that the level of the specific OH&S management system in relation to the resources devoted to it and the extent of documentation depend on a wide range of factors such as the size and nature of activities of the organization, its products, services and the organizational culture. Furthermore, the OHSAS standard outlines preconditions for an OH&S management scheme that empowers organizations to control and develop an appropriate risks assessment and performance structure. In the OHSAS document, a number of terms are used that needs to be defined with the specific legal interpretations which are also implied in this thesis.

Historically, the enforcement of health and safety regulations has brought with it enormous benefits. For example, its introduction in countries like Germany, the United Kingdom and virtually all around the world, the safety of workers has increase by imposing limits of methane and coal dust amongst others. There are also instances where people exposed to an organizations activity are able to evoke legal rights for their health and safety due to the above. (Leamon, 2001).

2.1.2. Integrated management system

There exist a number of safety management practices such as safety charters, self-regulation and benchmarking. However, it is a vibrant and active safety management system that helps to foresee potential industrial or organizational risk (Pun & Hui, 2002). Along these lines, an *Occupational Health and Safety Management System* established in an organization contribute immensely in health and safety management. In this wise, the control would be more effective as the system can be integrated to the comprehensive business activities.

2.1.3. Comprehensive safety management system

Although the utilization and certification of *environmental, quality management and occupational health and safety management systems* have become a prerogative for many organizations which are seen as an ethical image or better still, an achievement for better operational status, it is demanding to have many management systems work separately. OHSAS 18001 is moreover designed to be coordinated simultaneously to the aforementioned standards. All three standards can therefore be incorporated within an overall management system. A new international standard for OHSAS *Management System* known as BSI ISO 45001 is due to be lunched soon to replace this current standards. In view of that, OHSAS 18001:2007 is being used as the blueprint for BSI ISO 45001, and it

would be aligned directly to ISO 9001- Quality Management and ISO 14001-
Environmental Management (ISO 45001, 2015, s. introduction).

2.1.4. BSI ISO 45001

The ISO Technical Management Board (ISO/TMB) established a project committee in June
2013 to design a new standard and it is being created with the aim of replacing OHSAS
18001 with ISO45001. This upcoming standard is expected to be enforced by October
2016. It is being designed to be built on ISO 14001, ISO 9001 and OHSAS 18001.
Standards like ILO-OSH and other international labor standards are also being integrated
into ISO 45001(Kieinova, 2014). Key changes includes a higher involvement by
management, more emphasis on risk management, Increased strategic consideration of the
organizations operations, incorporation of performance indicators to track improvement,
etc. The new standard is being modeled to possess a higher level of integration into the
overall management practices (ISO 45001, 2015).

- Changes in the organizations structure

Whenever a need arises for changes to take place in the organizations procedures,
businesses or methods, it shall identify the perceived hazards and risks related to the said
changes and incorporate such changes in the OH&S management system before inception
of such changes. Attention shall be given to reduction or possibly elimination of risks by
the following procedure.

a. Elimination;
b. Replacement;
c. Arranging the oversight:
d. Signs, warnings and supervision.
e. *Personal Protective Equipment* (PPE)

Any outcome of results of hazard or risk identification due to these changes shall be documented accordingly. Subsequently, it also constitutes risks assessments and hazard identification.

(OHSAS 18001:, 2007)

- Documentation and Communication

The management system for OH&S shall include:

a. The scope, policy and objectives of OH&S.

b. Description and references to main documents of the ingredients contained in the OHSAS standard.

c. Required OHSAS standard documents and those of the organization to promote proper planning and control of safety and occupational health.

d. Procedures to revise, review and update relevant documents shall be established and monitored. These documents must be available, clear and easily identified (OHSAS 18001:, 2007, s. 10).

2.1.5. OHSAS 18002 Guidance Provision

The OHSAS 18001 documents define preconditions for OH&S management systems, to empower organizations in risks control and to enhance their OH&S performance. To achieve this, a system that defines the requirements is instituted known as BS OHSAS 18002. This provides directions and instructions on the application of OHSAS 18001. OHSAS 18002, in other words defines the requirements of specification, and establish procedure towards its registration, implementation and sustenance. Consequently, 18002 act as a check to control needed elements which enables an effective and efficient implementation of *occupational health and safety management system* - OHSMS (BS OHSAS-2007). OHSMS can be integrated with other management activities to enhance workers satisfaction in their health and safety and thereby advance the organizations

monetary interest and ambition. The international labor organization (ILO) also has a scheme established for the management of occupational health and safety which are similar and complementary to the OHSAS standard.

2.1.6. International Labor Organization (ILO_OSH) Vs. OHSAS 18001-2007

The main objective of the *International Labor Organization* (ILO_OSH) is to help countries to establish a national framework for *occupational health and safety management system* and also to provide directions to organizations in integrating OHS guidelines into a management policy.

There are many similarities between the OHSAS 18001-2007 and ILO-OSH guidelines. However, a few differences exist as elaborated below. It can notwithstanding be assured that organizations that have implemented an OH&S management system would be compliant with the ILO-OSH requirements. Section 3 of the ILO_OSH subtitled *"The occupational safety and health management system in the organization"* is comparable to the OHSAS documents. Some of the notable differences are *"The ILO-OSH Guidelines recommend in section 3.3.1(h) the establishment of prevention and health promotion programs. There is no requirement in the OHSAS Standards for this".* (OHSAS 18001:2007). For example, the ILO guidance states that training is a must for all participants at no cost and possibly, should take place during normal working hours. OHSAS again has no such requirement. While ILO-OSH specifies the incorporation of safety and health concerns into procurement and leasing of the organization, OHSAS addresses procurement for risk assessment, operational control and legal issues. There is no requirement under ILO-OSH guidelines for the review of risk determination before implementation as specified in the section 4.5.3.2 of the OHSAS documents. Under audit, *"*t*he ILO-OSH Guidelines recommend consultation on the selection of auditors. In contrast, the OHSAS documents require audit personnel to be impartial and objective.* While an ILO-OSH guideline focuses on the occupational safety and health of workers, OHSAS

considers the interest of all interested parties or stakeholders. Both OHSAS and ILO-OSH have equivalent management system models such as a framework for continuous improvement. The comparison between the paragraphs of the OHSAS documents and those of the ILO-OSH guidelines are summarized and listed below in Table 1.

Claus	OHSAS	Claus	ILO-OSH Guidelines
	Introduction	— 3.0	Introduction The occupational safety and health management system in the organization
	Foreword	—	The International Labor
1	Scope	1.0	Objectives
2	Reference publications	—	Bibliography
3	Terms and definitions	—	Glossary
4	OH&S management system elements (title	—	—
4.1	General requirements	3.0	The occupational safety and health management system in the
4.2	OH&S policy	3.1 3.16	Occupational safety and health policy Continual improvement
4.3	Planning (title only)	—	Planning and implementation (title
4.3.1	Hazard identification, risk assessment and determining controls	3.7 3.8 3.10 3.10.1 3.10.2	Initial review System planning, development and implementation Hazard prevention Prevention and control measures
4.3.2	Legal and other requirements	3.7.2 3.10.1	(Initial review) (Prevention and control measures)
4.3.3	Objectives and programme(s)	3.8 3.9 3.16	System planning, development and implementation Occupational safety and health objectives Continual
4.4	Implementation and operation	—	—
4.4.1	Resources, roles, responsibility, accountability and authority	3.3 3.8 3.16	Responsibility and accountability System planning, development and implementation Continual improvement

Table 1. Comparison of OHSAS and ILO-OSH: Adapted from (OHSAS 18001:2007)

Claus	OHSAS	Claus	ILO-OSH Guidelines
4.4.2	Competence, training and awareness	3.4	Competence and training
4.4.3	Communication, participation consultation	3.2 3.6	Worker participation Communication
4.4.4	Documentation	3.5	Occupational safety and health management system documentation
4.4.5	Control of documents	3.5	Occupational safety and health management system documentation
4.4.6	Operational control	3.10.2 3.10.4 3.10.5	Management of change Procurement Contracting
4.4.7	Emergency preparedness and	3.10.3	Emergency prevention, preparedness
4.5	Checking (title only)	—	Evaluation (title only)
4.5.1	Performance measurement and monitoring	3.11	Performance monitoring and measurement
4.5.2	Evaluation of compliance	—	—
4.5.3	Incident investigation, nonconformity, corrective action and preventive action (title only)	—	—
4.5.3.	Incident investigation	3.12 3.16	Investigation of work related diseases and incidents and their and health performance Continual improvement
4.5.3.2	Nonconformity, corrective and preventive action	3.15	Preventive and corrective action
4.5.4	Control of records	3.5	Occupational safety and health management system
4.5.5	Internal audit	3.13	Audit
4.6	Management review	3.14 3.16	Management review Continual improvement

Continuation of comparison of OHSAS and ILO-OSH: Adapted from (OHSAS 18001:2007).

2.1.7. OHSAS certification

Risks recognition, valuation and mitigating procedures are identified as key determinants necessary for OHSAS accreditation. These factors are needed for planning of effective

OH&S policy. (OHSAS 18001:2007:6). On account of this, constant vigilance for occupational health and safety are needed. As Steve Eichler puts it, safety and health should be seen as a colleague who is ever prompt and always available and who needs consistent scrutiny and has to be with the group throughout a project. (Eichler & Oppenheim , 2015).

OHSAS document outlines the following procedure for identification of a number of hazards, likewise assessment of risk and hazardous occupational conditions.

a. It shall be mandatory for the organization to institute, implement and sustain procedures for hazard identification, risks assessment and the needed supervision.

b. This procedure shall include periodic and unregulated activities geared towards this objective. Assessing continuously any risks in the vicinity of the organization and by any action associated to its functions under the mandate of the organization.

c. Furthermore, these procedures shall also cover the materials, infrastructure and machines supplied by the organization or contractors.

d. An essential part shall be the alteration of the OH&S management system and its effect on activities and procedures to suit the organizations setting.

e. Design of the workshop, operating methods, installations of machines and equipment shall as well be under the direct supervision of management.

f. Monitoring of the activities of people with access to the workplace is also part of the risks assessment procedures.

g. Organizations shall likewise look beyond its environs to locate and identify any potential hazards capable of negatively affecting its staffs health and safety. This should be dealt with after the said identification.

h. The organization's method of risk and hazard identification shall be proactive instead of reactive. It comprises recognition, prioritization and documentation of risks to ensure its appropriateness.

(OHSAS 18001:, 2007, ss. 6-7).

- Legal requirements:

Any organization that wishes to be accredited to OHSAS and for that matter continue to improve on its health and safety policy has to abide by OHSAS regulations. It shall therefore be obligatory for the organization to set in place and control any OH&S requirements that are applicable to it. These legal requirements are to be considered during establishment, implementation and control in the OH&S management system (OHSAS 18001:, 2007, s. 7). The legal requirement also provides a clause in regard to safety and health if any substantial change is made during execution of contractual or procedural operations of the company.

- Internal audit and management review

In order to determine and ensure proper implementation, maintenance, conformance and effectiveness of the OH&S management systems, the organization shall conduct periodic internal audits. Wherefore it shall be the responsibility of top management to review this system to ensure its continuous appropriateness, sufficiency and effectiveness which includes but not restricted to:

a. Compliance of the results of internal audits to legal requirements;
b. Evaluation of complaints and communications from interested parties;
c. Evaluation of the OH&S performance of the organization and extent to which this purpose has been met; and the
d. Development and improvement recommendations.

(OHSAS 18001:, 2007, ss. 13-14)

- Correspondence between OHSAS, Environmental, and Quality Standards

While OHSAS is a standard designed for the measurement, improvement, control and maintenance of *occupational health and safety system*, ISO 14001 provides a policy for analysis of environmental impacts of an organization. On the other hand, ISO 9001 as a quality management standard provides accredited organizations with a meticulous approach for fulfillment of customer objectives. An organization that wishes to integrate these three has three options listed from (a) to (c) below to select from. Comparison of these 3 standards is adapted from the Integrated Standards.

a. To continue using the two initial systems of environment and quality standards;
b. Have a partial integration system;
c. A fully integrated system:

Sec.	ISO 9001	Sec.	ISO 14001	Sec.	OHSAS 18001:2007
0	Introduction		Introduction		Introduction
0.1	General				
0.3	Relationship with ISO 9004				
0.4	Compatibility with other management systems				
1	Scope	1	Scope	1	Scope
1.1	General				
1.2	Application				
2	Normative references	2	Normative references	2	Normative references
3	Terms and definitions	3	Terms and definitions	3	Terms and definitions
4	Quality management systems	4	Environmental mag. System requirements	4	OH&S management system elements
4.1	General management	4.1	General management	4.1	General management
5.5	Responsibility, authority and communication				
5.5.1	Responsibility and authority	4.4.1	Resources, roles, responsibility and authority	4.4.1	Resources, roles, responsibility and authority
5.1	Management commitment	4.2	Environmental policy		OH&S policy
5.3	Quality policy				
5.4	Planning	4.3	Planning	4.3	Planning
5.2	Customer focus	4.3.1	Environmental aspects	4.3.1	Hazard identification, risk assessment and determination controls
7.2.1	Determination of requirements related to the product				
7.2.2	Review of requirements related to the product				
5.2	Customer focus	4.3.2	Legal and other requirements	4.3.2	Legal and other requirements
7.2.1	Determination of requirements related to the product				
5.4.1	Quality objectives	4.3.3	Objectives, targets and programme(s)	4.3.3	Objectives and programme(s)
5.4.2	Quality management systems planning				
7	Product realization	4.4	Implementation and operation	4.4	Implementation and operation
8	Measurement, analysis and improvement	4.5	Checking	4.5	Checking
8.2.2	Internal audit	4.5.5	Internal audit	4.5.5	Internal audit
8.5.2	Corrective action	4.5.3	Nonconformity, corrective and preventative action	4.5.3.2	Nonconformity, corrective and preventative action
8.5.3	Preventative action				

Table 2. Adapted from (Integrated_Standard, 2015). Comparison of OHSAS 18001, ISO 14001 and ISO 9001.

The table above provides a comprehensive comparison of the trio. Generally, some sections are identified to be familiar to all three standards. These are summarized as:-

a. Structure and obligations;

b. Training, recognition, realization and capability;

c. Authority on the document and regulation;

d. Records control and keeping;

e. Corrective and precautionary measures;

f. Domestic auditing and review:

((OHSAS 18001:2007. Integrated standards. Transpacific Certifications, 2015).

2.1.9 Benefits of OHSAS 18001:2007

The main advantage of the OHSAS management system is that it can be integrated to other management requirements to promote OH&S in addition to advancing economic objectives. Furthermore it enables organizations to implement policies and objectives by taking into account statutory legal requirements and policies about OH&S risks. Organization therefore demonstrates diligence to health and safety; thereby minimizing risks to workers by improvements or institutionalization of an OHS management system. Having the capability to be applicable to all sizes and types of organizations irrespective of its geographical or social condition, OHSAS's overall aim is to promote and support the optimum OH&S practices. Thus interested parties such as workers, customers and suppliers can be assured that an appropriate OH&S management system is in place. Companies that have been accredited to this standard can be assured of meeting the health and safety legal requirements of the territorial state in recognition to the country's ILO-OSH guidelines. Other advantages that companies can benefit from are -

a. Drastic reduction of potential work place hazards and accidents.

b. To locate and identify potential causes of accidents (occupational hazards) and to minimize health and safety risks.

c. Ensures that all the needed factors and elements concerned in its OH&S are clearly defined.

d. Improves employee's awareness to risky conditions and situations.

e. Improve health of workers and also control or mitigate risks.

f. Reduction in sick leave/absenteeism due to occupational related injuries and ill health.

g. Improves the health and fitness of workers to reason and act according to the company's goals and aspirations.

h. Reduction in insurance premiums becomes a surplus.

i. Assurance to company's objectives compliance is therefore enshrined in it's the day to day activities.

j. It as well helps in the avoidance of legal fines and lost productivity.
(OHSAS 18001:, 2007).

The role Management plays comprises leadership, vision, control, commitment, supervision, safety analysis, and preventive methods. In 2008, Mearns and Reader conducted a study outlining relations between anticipated organizational support and health support from supervisors and colleagues, and '*safety citizenship behavior*' (SCB). The outcome indicated that the SCB increased substantially following the high levels of support at both organizational and supervisory levels showing care and concern for the well-being of workers (Mearns & Reader, 2008; Zubaidah l ;Samad ;& Zakaria, 2012).

2.2. A Learning Organization

According to the online Business Dictionary, "*a Learning Organization is an Organization that acquires knowledge and innovates fast enough to survive and thrive in a rapidly*

changing environment. Learning organizations create a culture that encourages and supports continuous employee learning, critical thinking, and risk taking with new ideas, it therefore allows mistakes and value employee contributions thus making it possible to learn from experiment and experience." Wherefore, an organization can achieve the greatest benefit from its workforce when it encourages learning. Knowledge impartation is vital to a company's progress in the current competitive environment and it has been seen as the driving force to propel the fortunes of any organization. For this reason, encouraging an enabling atmosphere for workers to share useful information within the organization can raise the company's competitive advantages (Liu & Philips, 2011). Based on this idea, the innovative capability is undoubtedly enhanced which suggests that employee knowledge sharing promotes organizations prospects to desired productivity levels (Grant, 1996; Liao;Fei;& Chen, 2007).

Consequently, this innovative concept is known as *knowledge society*. Explanation is that knowledge should not be seen parallel to traditional components of production such as capital, labor, equipment or land but that it is "*the only meaningful resource today.*" Contenting further that knowledge is the resource rather than just a source (Drucker, 2011). This assetion is further buttressed by Toffler that knowledge creation of the highest-quality is preceding other manufacturing factors. Essentially, it is seen as a capabitlity that it is the driving force for the future shift in power. He also states that knowledge is paramount to any other resource (Toffler, 1990, s. 7). Quinn reinforces Toffler and Drucker's idea on the capability of knowledge as top notch. It can further be expressed that this intellectual and know-how power of today's employee is spearheading the firm's collective capabilities and core competences. While this is the case, he pointed out that the monetary worth of products and services are built upon the "*knowledge-based intangibles*" like technological ingenuity, commodity design and marketing strategies (Quinn, 1992). Undoubtedly, these philosophical gurus have a common stand that the future lies in the hands of those equipped with knowledge. Complemenary to this, Alvin Toffler laments that the current society of mankind is knowledge based. In that knowledge has become the antecedent of the endowment for the potential of capability. Thus in the rapidly changing dynamics of

products, technologies and regulations, the constant modernization of know how that is accredited to such innovative ideas is a vital sources of sustainable competitive advantage (Toffler, 1990, ss. 7-8). In contrast, Nonaka argues that the organization should not exist solely to work by laid down rules, procedures and methods as in single loop of learning but need be seen as a dynamic force that creates new knowledge by its activities and interactions (Nonaka & Noboru, 2000, s. Introduction) Thereby, the earlier made assertion contrary to Western view of knowledge as being explicit is sustained; The world wide attention on the importance of knowledge in inductsry is growing. The work of Nonaka and Takeuchi that addresses the creation of knowledge adequately. Accordingly, it is used extensively in this research as the bases of this theory.

2.2.1. Organization Knowledge Creation:

Knowledge can be defined as a "*justified personal belief.*" Amongst the vast taxonomies of knowledge definition, the most basic distinction is between "tacit" and "explicit" knowledge. By the implementation of a continuous series of improvements of knowledge embedded in activities of businesses, factory processes and the like, a concreate level of know-how can be achieved (King W. R., 2008, s. 1). King Explains further that knowledge can be distinguished into 3 levels being,

a. Know what - (Knowing what action to take at a given point in time);
b. Know how – (Knowing how to decide in a response to a situation);
c. Know why – (Having an in-depth knowledge and understanding of a causal relationship, connected effects and the uncertainties in relation to observed stimuli or syndrome (King W. , 2009, s. 2).

- **Tacit Knowledge:**

The concept of tacit knowledge in other words informal knowledge originated in 1966 by Michael Polanyi (1891-1976) in a book titled '*The Tacit Dimension*'. Definition of the business dictionary states it as the unspoken, unwritten, and private boundless amount of knowledge that every normal human being has. Additionally, it is based on knowledge acquired through experience, observation, intuition, talent and internalized information. Tacit knowledge is gained mainly through interaction and association with others. According to (Nonaka & Takeuchi, 1995, s. 8) it is neither easily seen nor expressed. In other words, it is also difficult to define or explain to others. A popular statement by Professor John Nickolas in 2010 also explains *that tacit knowledge cannot be articulated*. That means it can neither be easily expressed, formulated nor presented clearly and effectively. Consequently, it is transferable as people work together, talk and do things in common. Due to this nature of tacit knowledge, it can therefore be transferred through much personal contacts. Moreover, in the likely event of an employee leaving the organization after acquiring that enormous amount of knowledge, he or she departs with such an important asset of an organization (Davenport;Prusak;& Prusak, 1997, s. 81). It can also be particularly problematic when people after many years of experience proceed on retirement. To curtail this problem, effective strategies and programs need be instituted by management to manage that intellectual asset within the workforce to ensure a continuous transformation of the firm's corporate expertise and know-how into market value. Nonaka recently stated that although tacit knowledge can be viewed as unscientific, however, for the knowledge creating firm to be successful it must convert knowledge created by the convergence of both tacit and explicit knowledge to yield the desired streams of profit (Wuvienna, 2012).

- **Explicit knowledge:**

The Business dictionary defines explicit knowledge as "*knowledge that is articulated*". In other words, it can be expressed and also recorded as words, numbers, codes, mathematical and scientific formulae, and musical notations. It further states that explicit knowledge is

easy to share, circulate, store, and distribute. Example is knowledge in books, websites and other retrievable media. Explicit knowledge is represented in writing such as texts, books, data, scientific formulae, manuals etc. As a result, it is easily processed, transmitted and stored in any format. In short, it is conveniently expressed, transmitted and seen as images, drawings, pictures, plans and writings (Nonaka & Noboru, 2000).

2.2.2. Tacit and explicit knowledge

Nonaka however mentions that tacit knowledge and explicit knowledge are not completely separate and that there exists some amount of interaction as shown in figure 3. In creative activities, this interaction is popularly known as knowledge conversion which is likewise elaborated in figure 4. A critical analysis of the SECI model provides a dynamic method of enhancing the potential of individuals and collective capabilities of organizations by being more innovative (Nonaka & Takeuchi, 1995, s. 61). It follows that, the interactive relation that exists in the model between explicit and tacit knowledge needed for learning in organizations needs to be technically inculcated into the workforce as an organizational culture.

TACIT KNOWLEDGE	EXPLICIT KNOWLEDGE
Know-how that cannot be expressed in figures, words, sentences, numerical values nor formulas (context-specific).	Knowledge that is objective and rational. It can be expressed in words, sentences, numerical values and formulas (context-free).

➢ Technical Skills
▪ craft,
▪ ingenuity
➢ Cognitive Skills
▪ beliefs
▪ perspective
▪ images
▪ mental models

➢ Theoretical approach
➢ Problem solving
➢ Manuals
➢ Database

**Dynamic Interaction.
Analog-Digital Synthesis**

Figure 3. Knowledge Interaction (Asian Productivity Organization, 2014).

2.2.3. Types of Knowledge

Knowledge is basically created in an organization by the interaction of tacit knowledge and explicit knowledge. This interpersonal communication promotes knowledge disbursement by a module popularly known as the knowledge spiral. Knowledge spiral has 4 modes of conversion being *socialization, externalization, combination and internalization*. Additionally, in creating knowledge, there is a place in which it is shared. This is known in Japanese as Ba (Nonaka;Umemoto;& Senoo, 1996; Nonaka & Noboru, 1998). The 4 modes of knowledge conversion are defined as:

1) Socialization: Knowledge conversion from (*tacit to tacit*);
2) Externalization: (*tacit to explicit*);
3) Combination: (*Explicit knowledge to explicit knowledge*);

4) Internalization: Knowledge transferred from explicit to tacit knowledge.

(Nonaka & Takeuchi, 1995, s. 62), (Nonaka et al., 2000:7).

2.2.4. Knowledge conversion process

The 3 elements embodied in the model of knowledge creation in figure 4 proposed by the trio are;

a. Converting tacit and explicit knowledge to create an SECI spiral or process to form knowledge creation spiral.
b. Collated context of knowledge creation known in the Japanese language as 'ba' roughly translated "place".
c. Knowledge assets: This constitutes the inputs, outputs and mediators or moderators of the process of knowledge-creation.

The spiral of knowledge creation in figure 4 is made up of the above 3 elements which are embodied in the 4 modes of knowledge conversion – SECI model below (Nonaka et. al, 2000: Introduction).
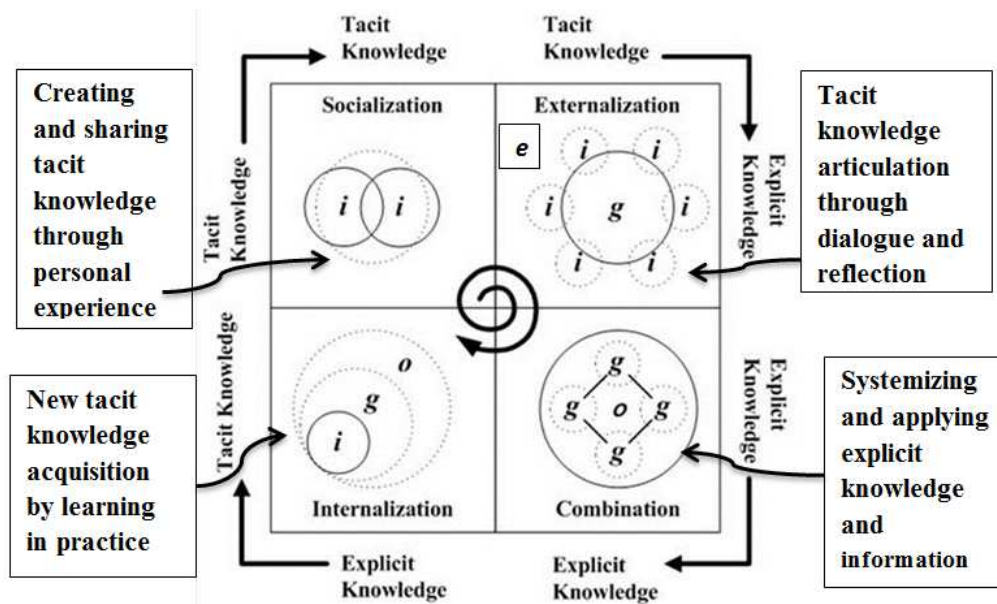
KEY: *i* = individual, *g* = Group, *o*= Organization, *e*= Environment

Figure 4. SECI Knowledge creation Spiral (Nonaka & Takeuchi, 1995)

Knowledge conversion is accordingly defined as the interaction of explicit knowledge and tacit knowledge and by this relationship organizations (*o*) create knowledge. A substantial amount of increase in quantity and quality in both tacit and explicit knowledge is realized through this conversion process (Nonaka et al., 2000) (Nonaka & Krogh, 2009). The four processes are explained below.

- Socialization:

This is the process of converting the individual's (*i*) tacit knowledge to others mainly through interaction. Particularly, socialization entails the creation of tacit knowledge by sharing skills and actions through interaction. It could also be through conversations that reveal ones view of the world, *mental models* and interactive (mutual) trust (Nonaka 1995:62, Nonaka et al., 2000:7). At a factory, socialization can be promoted by employees working together and shearing workplace experiences. To ensure this socialization process, management ought to purposefully create activities and interactive events with suppliers, customers and workers.

- Externalization:

Knowledge converted from tacit to explicit is termed externalization. It is usually seen in the creation of theory which can be established on communication or collective reflection. Externalization consequently creates fresh explicit concepts or diagrams by using sketches, metaphors and analogies from tacit into explicit knowledge (Nonaka 1995: 64-67), (Nonaka et al.1996: 206). The creation of a product concept can be seen as an example of Externalization. Likewise, Nonaka explains in a speech that externalization condenses the essence of awareness into a concept (Wuvienna, 2012).

- Internalization:

This is the process whereby explicit (clearly defined) knowledge is incorporated into tacit (inarticulate) knowledge. By internalization, available explicit knowledge is shared throughout the company which becomes tacit knowledge of individuals (Nonaka, 2000; 11). Nonaka furthermore explains that "*internalization is closely related to learning by doing*". Which means vital processes and strategies a firm uses in its business has to be realized in practice by actions or deeds. Newcomers can absorb or be imputed by "internalization" of the documented methods and means to cultivate a broad knowledge in that venture. An effective means of transferring explicit knowledge into tacit knowledge is by documenting information verbally or diagrammatically. By so doing, internalization becomes easier as popularly seen in children's books (Nonaka, 1995:69).

- Combination:

Nonaka defines combination mode of knowledge conversion as '*a process of assembling new and existing explicit knowledge held by individuals into a knowledge system*' (Nonaka et al., 1996, p207). In general terms, combination is the systematization of concepts into knowledge systems. Combination could be from diverse web sources, documents, meetings and conversations (Nonaka 1995: 67-68). By combination, a firm can stimulate the emergence of new knowledge in the organization, market and the environment. Additionally, combination scrolls up to the socialization process through a continuous and

rapidly spinning spiral which is built to synthesize this capability to peruse its goals and aspirations (Wuvienna, "The wise leader" Prof. Dr. Ikujiro Nonaka, 2012).

The idea of organizational knowledge creation is not static but a continuous course of active interactions between tacit and explicit knowledge thereby upgrading itself continuously (Nonaka et.al. 2000; 15). Knowledge is termed as crystalizad when tacit knowledge is allowed to flow explicitly. Which according to (Davenport;Prusak;& Prusak, 1997) a lot of personal interaction is necessary to ensure it's transfere. These factors contribute to the importance of knowledge management in organizations.

2.2.5. Knowledge management

Knowledge management can be defined as the optimization of the highest benefit from available knowledge resources. Knowledge management has existed for more than 3 decades now and gaining popularity which indicates its importance and multidisciplinary nature (Girard, 2015). Knowledge Management grants an organization the possibility of making available the right knowledge to the right people at the right time. Meanwhile it enables the "right" people to use their knowledge while sharing to enhance organizational performance (O'Dell & Hubert, 2011). Similarly, it is the planning, establishing, inspiring and control of all resources such as systems, people and processes in the company to promote learning and knowledge in diverse formats. Hence knowledge management is seen as a vital venture that enhances the corporation's knowledge creation, sharing and learning processes (Becerra-Fernandez & Sabherwal, 2010, s. 4). Knowledge is typically related to our actions (Nonaka 1994:59) and that knowledge becomes social as humans collaborate with each other. (Senge, 2006, s. 270). A culture of learning incorporated would automatically create a transfer of gained knowledge from past and current projects. As an enviable asset for the organization, it would help to inculcate this knowledge in the organizations products, processes and dealings. Much emphasis has been placed on creation of tacit knowledge in relation to productivity benefits through knowledge management.

- Advantages of knowledge management

The advantages of the management of knowledge are numerous. It enables organizations in identifying, creating, acquiring and distributing the relevant knowledge needed for its business. Another key advantage of knowledge managemnt is that it utilizes knowledge asset available in the institution to improve performance and create a much advantageous level of innovation. Unlike the former "traditional" manufacturing asset such as cash, stocks and land, our generation embrases a knowledge-based economy which replaces the former with intangible asset of knowledge management to the organizations competitive advantage (Asian Productivity Organization, 2014).

Furthermore, Nonaka and Takeuchi argues that the success of the Japanese companies was not actually due to access to cheap capital, cordial relationship with customers and other human resources practices; although these are important, but mainly due to their competence at organizational knowledge creation. This, they define as "*the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services, and systems*". (Nonaka, 1995:3). Like the concept of continuous innovation which propelled the Japenese industry, knowledge management broadens corporations vision while assuming market and technological changes to affect its products or services positively. They further state that by contacting suppliers, customers, distributers, government agencies and even competitors for new ideas or plans that could be offered, companies become more productive even in turbulence (Nonaka, 1995:4-5). This can be visualized in figure 5 below.
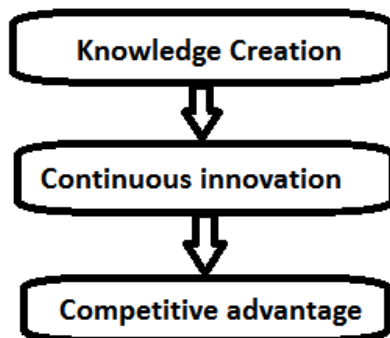
Figure 5. Knowledge creation as a competitive resource: (Nonaka 1995:6).

- Knowledge creation through knowledge management

Figure 6 below explains the alternative paths in important decision making to ensure best practices. It involves creation or purchase of knowledge by a company. This requires developing fresh ideas and strategies or changing existing knowledge with new ones (Nonaka, 1995, 6-7). By having the 4 modes of knowledge creation listed under creation in the diagram, the model consequently elaborates the main issues after the knowledge creation concept. These are acquisition and refinement "distillation" before being put into memorable formats which can be transferred and/or shared. It is interesting to note that the utilization of knowledge gained proceeds after sharing and transfer. It can be seen therefore that the performance of the organization becomes the final stage. It is worth stating however, that in as much as individuals can perform each of the *knowledge management* steps, it is mainly designed as an organizational activity to motivate individuals within the firm to participate or contribute to the general goal of promoting learning.
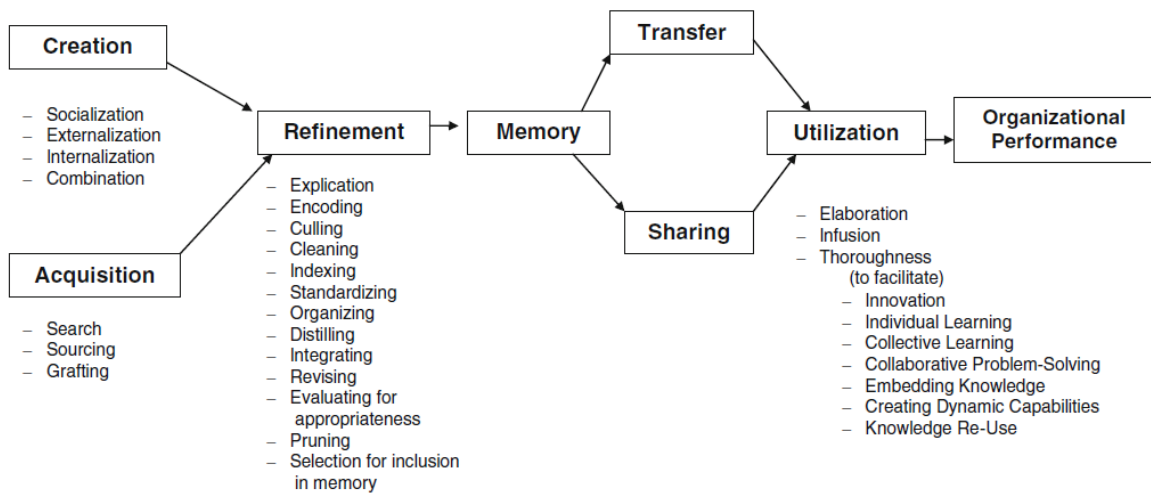
Figure 6. Knowledge management process model; Adapted from (King W. R., 2008, s. 7).

King explains that although *Knowledge Management* is human dependent, modern methods to support it should involve the use of relevant information and communication technology (King W. R., 2008). He further states that *knowledge management* should be seen as the process of converting knowledge achieved within organizations or external sources to the relevant explicit knowledge of employees to build and/or modify the entire organizational knowledge creation (King W. , 2009, s. 28). This is illustrated in figure 7 below.

Figure 7. Knowledge management model; Adapted from (King W. , 2009, s. 28).

King advices that a key concept in managing knowledge is for organizations to present the acquired knowledge in a form that is available, accessible and distributable. As shown in

figure 7, the knowledge management module involves circulation and conversion of explicit information through knowledge creation that yields the required tacit knowledge which becomes organizational knowledge and then the cycle continues. Due to current fast changing business dynamics, this cycle should be never ending to inculcate new ideas for product designs, industrial processes and marketing strategies which ultimately ensure a tremendous industrial success and growth. This cannot be achieved without a healthy being working in a safe and flexible atmosphere.

2.2.6. Knowledge shearing

Other studies signals that this concept of knowledge sharing within employees can impact positively on revenue and profits. Subsequently, the study revealed that some great minds leave companies because of the feeling that their knowledge is underutilized (Becerra-Fernandez & Sabherwal, 2010, s. 74). Perhaps managers only see the seriousness when the departed "knowledge" appears at the competitor's side. Not adhering to modern methods of knowledge creation and therefore learning could have catastrophic consequences as the good book says "*My people are destroyed for lack of knowledge*" (Hosea 4:6 KJV). Significantly, the great theoretical physicist Albert Einstein also suggests that "*We cannot solve our problems with the same thinking we used to create them*". He further explains that "*Insanity means doing the same thing over and over again, expecting different results*". These buttress the relevance of management inculcating knowledge creation especially in the current information age. With the advent of computers, the internet and smart phones, the half life of knowledge keeps reducing as seen in the reduced shelf-life of products. Dynamic organizational learning methods cannot be over emphasized.

- Organizational Knowledge creation process:

Nonaka outlines 5 conditions that promote organizational knowledge creation. These are: -

a) *Intention*: The first is the intention of the firm and can be defined in this context as the organizations objectives and ambitions to the goals set.

b) *Autonomy*: Secondly, an autonomous condition needs to exist to promote the knowledge spiral. That new knowledge can be created when each person is allowed some level of freedom or liberty in their responsibilities.

c) *Fluctuation and Creative Chaos*: Thirdly, a condition that stimulates the knowledge spiral has been arguably identified as fluctuation and creative chaos. This, Nonaka states that it has the tendency to trigger interactions between organizations and external conditions. By introducing some amount of fluctuation, normal work routine and thinking is agitated and thereby leading new ideas for progress.

d) *Redundancy*: The fourth condition that empowers the knowledge spiral is controversially redundancy. Understandably, Nonaka explains that redundancy in this situation refers to information given out that is not immediately needed by work force and not the traditional meaning of workers idling. By this redundancy approach, a climate of interaction and socialization needed for tacit knowledge enlargement springs up.

e) *Requisite variety*: Fifthly, a situation necessary for the spiral is requisite variety. This implies domestic variations of organization should match dynamics of external environments so as to tackle these changes proactively.
(Nonaka 1995:73-83).

- Models of the organizational knowledge creation process

From the four modes of knowledge conversion being Socialization, Externalization, Combination and Internalization (SECI) and the above five enabling conditions for organizational knowledge creation, a unified model of five phases was developed in figure 8 being:

a. *Sharing tacit knowledge*;
b. *Creating concepts*;
c. *Justifying concepts*;

d. *Building and architype*;

e. *Cross-Leveling of knowledge*:

These are linked to one another as seen in the diagram. It starts with *sharing tacit knowledge* as first step in organizational knowledge creation process which represents socialization as indicated above the circle in the diagram. The second step is the *creation of concepts* by shared tacit knowledge that has been converted to explicit knowledge such as in externalization. For the new concept to be practicable and profitable, it moves on to the third stage known as *justifying concepts*. After justification, it then enters the fourth phase being *Building an archetype*. This archetype is a new model of the product or a strategy as in service delivery. Lastly, the *Cross-leveling knowledge's* in which the new concept is spread through the divisions or sections of organizations and possibly to external stakeholders. This then drives to the advertisements, patents, products or services as seen below (Nonaka 1995:83-90).
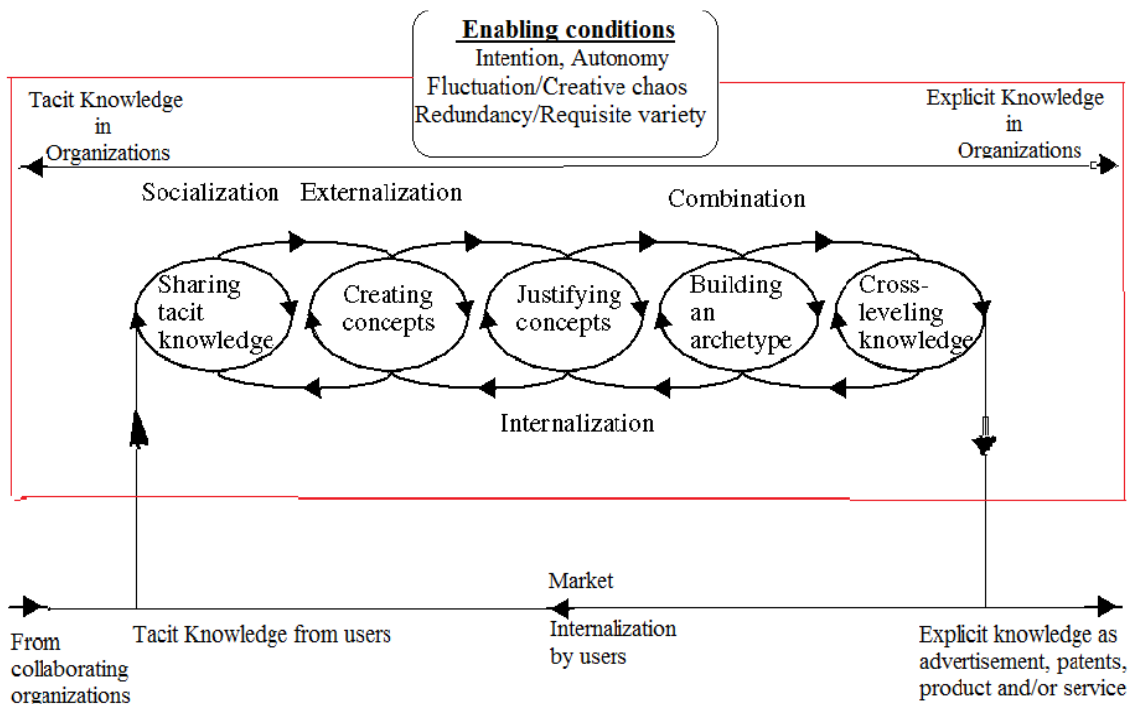

Figure 8. Five-phase model of knowledge creation process (Nonaka 1995:84).

As each component of the SECI organizational knowledge creation process interacts with one another, the spiral is produced as in figure 8. Similarly, the process continues through enabling organizational conditions in the figure being *intention, fluctuation/Creative chaos, autonomy, redundancy*, and *requisite* variety enable the knowledge spiral transformation process. For the process to be interactive and continuous, it enters into the five phase model of organization knowledge generation process of *sharing tacit knowledge, creating concepts, justifying concepts, building and architype* and *cross-Levelling of knowledge*. The diagram shows the two spirals that interact and revolves continuously to create the transformation process needed for innovation and eventually, the progress of the firm.

2.2.7. Organizational Learning

There exists some relation between *knowledge management* and organizational learning. While knowledge management targets the acquisition and creation of the needed knowledge, organizational learning is mainly about the processes. In short the content of the knowledge. Holistically, organizational learning is the goal of knowledge management (Easterby-Smith & Lyles, 2003). Furthermore, Kings explains that:-*"From this perspective, organizational learning is one of the important ways in which the organization can sustainably improve its utilization of knowledge."* (King, 2009:5)*.* Apparently, organizational learning deals with modifications of arrangements by a company to revamp itself in response to internal or external changes – having a culture of learning (Appelbaum & Gallagher, 2000, s. 4).

- The culture of a learning organization

Learning in organizations is effective and promoted when a learning culture exists. The *Fifth Discipline* outlines five conclusive disciplines of the culture of a learning organization described below.

1) *Personal Mastery*: Compares the vision of the company to the reality on the ground. By so doing, a tension is created that needs to be bridged. Personal mastery is enhanced by building the capability and capacity of the individuals in the firm by incorporating personal and organizational learning goals. - This develops skills and new ideas.

2) *Mental Models*: To practice openness to change "*this is the way it has been done syndrome*" - nurturing and encouraging new ideas.

3) *Shared vision*: That every employee is brought on board towards common objectives for progress. All workers can participate in a dialogue that enables workers to focus on the goal. Thereby breaking divisional barriers and destroying the too common and unnecessary competition amongst workers and groups.

4) *Team learning*: In this wise, workers learn together or from one another. An important concept; where both tacit knowledge and explicit knowledge are disbursed.

5) *Systems thinking*: This is about developing a holistic vision in which a employees see that change in any part of the company affects the entire system. It encourages viewing the organization as an ecosystem where each division contributes to the progress o retrogress of the organization.

(Senge, 2006, ss. 129-233).

- Benefits of organizational learning

The benefits of organizational learning are numerous and therefore it needs to be explained and elaborated vividly due to the fact that it can easily be under estimated and its value underutilize. Non quantifiable assets such as knowledge creation can have that tendency. For that reason, the needed knowledge must be aligned to the company's corporate strategy to determine the required resources and how progress and successes can be measured (Appelbaum & Gallagher, 2000, s. 40).

 It is a known feature for companies in this decade to claim to be more customer focused. With regard to that, knowledge management towards greater customer intimacy would ultimately be the key (Carneiro, 2000). These benefits are summarized below:

a) The organization that incorporates a learning culture becomes more efficient in its businesses;

b) Productivity gains increases significantly;

c) As productivity is enhanced, profits also increase.

d) Workers become more satisfied with work which raises their integrity as they become more patriotic.

e) A continuous improvement mentality is inculcated as workers begin to develop a shared ownership/responsibility for projects and therefore being accountable for the outcome.

f) Provides an environment for leaders to emerge at all stages and thereby foster an automatic succession plan.

g) An exploratory and inquiry culture is created while having an adaptive capacity and knowledge sharing.

h) The entire team and the individuals become adaptive to change by welcoming   fresh ideas and becoming more flexible.

(Business In Vancouve., 2014).

Hence, it is imperative to embrace a culture of learning within any organization that seeks to be successful in the current age of technological innovation and rapidly changing market dynamics. Failure to adhere to current realities and predictive future trends results in what happened to a giant in photography: - Kodak which pioneered and indeed championed the manufacture of films used in camera in the early 70's and 80's. However, it ignored a proposal by one of its workers in 1970 to shift to digital cameras and subsequently continued on film making that led to the company filing for bankruptcy in 2012. Kodak failed to welcome the radical change necessary for survival (Bergstein, 2012). A typical example of a company's inability to learn by creating new knowledge that resulted in financial crises. Figure 9 tells the story of the decline of analogue cameras and the popularity of digital camera; appertaining thereunto Kodak's failure to look forward and create new knowledge even though it had the capability for the needed change.
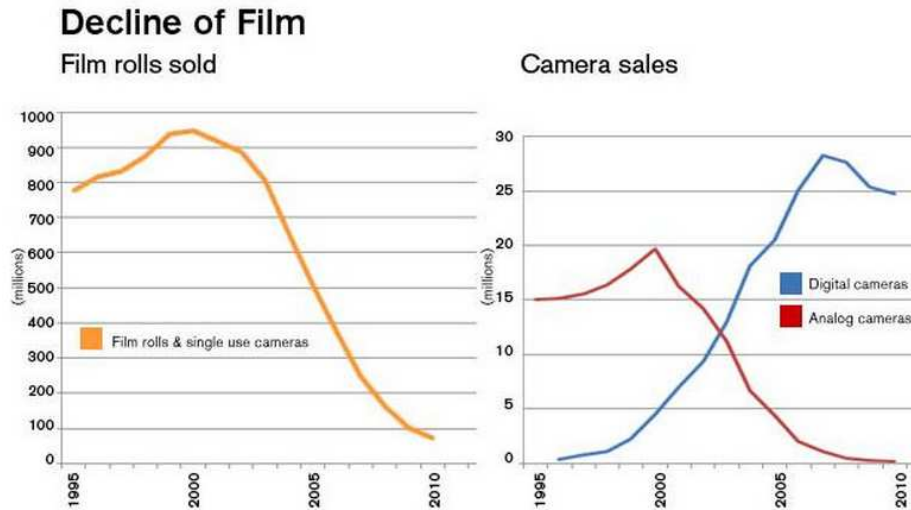
Figure 9. Kodak's decline as it failed to adapt to global changes (Bergstein, 2012).

- Considerable factors for training

A number of points have been considered that provide an enabling environment and condition for training in organizational learning as outlined. These are:

a) The development of key personal by managers to train others in knowledge transfer by the use of available technology as part of the organizational culture of learning and also to identify any hindrances to learning.

b) Managers must provide an enabling environment for the acquisition, improvement and transfer of knowledge that would promote interpersonal interaction to support the transfer of tacit knowledge.

c) Support for an experimental mind set by trying new things, accepting failure, welcoming changes in working techniques and processes.

d) Having a climate of openness by making information accessible. Resolve problems and errors by sharing and discussing.

e) Support for growth and development by management's commitment to continuous education at all levels of the organization.

f) Employees are to be accorded the opportunity to learn faster than the organization so as to teach and train others in their group.

g) Communication, as a critical factor for a learning organization that plays an important role in the successful implementation of any change. This is in line with the popular quote by Martin Luther that "*you are not only responsible for what you say, but also for what you do not say*".

(Appelbaum & Gallagher, 2000, ss. 11-12).

These factors outlined cannot be implemented at an instance and they need to be embraced by all the workers in an institution. This is due to the fact that the implications for training in organizational learning cannot be rigid but need to be built within the individuals as part of the organizational culture. The organizational culture should also contain a safety culture dimension.

2.2.8. Safety Culture

According to Douglas Cullen, safety culture is an atmosphere in which safety is seen and recognized as the number one priority (Cullen;Cullen;& Great Britain Department of Energy, 1990). In other words, it can be defined as the attitude and perceptions that workers and management have towards safety (Cooper, 1998). Being culturally inclined, it is seen as part of the organizational culture. On an individual level, safety culture can be defined as the way and manner workers work when not being watched. Safety culture is expressed in this research work as in an industrial environment with hazardous substances, flammable gases, extremely high temperatures and high voltages. Being a concept about human life, a safety culture need be seen as a crucial factor in high risks industries. Therefore as a necessary factor for consideration, it must be promoted and encouraged at top management. Generally, safety does not only depend on the technical systems in place but more predominantly on the people and the culture of the organization.

It is generally understood that safety levels of organizations ascend as a culture of safety is developed within the workforce. In this regard, the safety culture is embedded in the general organizational culture. This means that employees need a conscious mindset on their individual safety likewise the safety of others and the work place. Besides this, many researchers have identified that management leadership and commitment to safety, organizational learning atmosphere, interactive communication, reward of safety related issues and individual awareness of safety are among the main elements that build up a safety industrial culture (Thompson, 1998). As essential as it is, a prevailing trend of workers attitude and opinion towards – "*safety climate*" requires consideration.

2.2.9. Safety Climate

Safety Climate often refers to employees' impression or feeling of the organizations approach and level of importance and commitment shown towards safety. As determined by workers, an organizations safety climate can inform workers of the need to tack action to prevent workplace injuries. According to a renowned Scientist; Dr. Phil Bigelow at the Canadian Institute for Work & Health, generally safety climate has a gargantuan possibility of improving an organizational health and safety performance by the reduction of workplace injury rates (IWH, 2007). He further stated that if an organization is able to consistently monitor its safety climate, then potentially, it would lead to sustainable improvements in OH&S performance. In view of this, safety climate can be seen as the comprehensive arrangements and objectives that prevail in an organization in relation to the overall safety of people, the environment and facility. Safety culture and Safety Climate are frequently used synonymously and usually within the same context. In as much as both can be used interchangeably in connection to the safety attitude of the organization, safety climate is indicative of attitudinal behavior of workers (Olive, O'Connor, & Mannan, 2006). A tool identified to critically analyze and determine the level of safety culture, availability of protective equipment, atmosphere, and management commitment amongst

other factors is the **Serpentine 2.0** of the Evolute LLC that grants a perceptive solution to discovering personal competences as well as organizational objectives.

3. RESEARCH METHODS, TOOL AND CASE COMPANY

This chapter explains the research methods employed, procedure for obtaining required data and the research tool used. Herein, the kind of business, environment and status of the case company engaged are all explained. There has been a tremendous increase in the awareness of the importance of the human factor and ergonomics (HFE). Accordingly, research on occupational safety and health of workers, the use of mixed research methods has subsequently increased (Carayon, ym., 2015). The main research tool used is the Serpentine module of Evolute. Serpentine is built on safety culture and organizational learning ontology. Interviews and participatory or better still interactive research automatically became necessary as tools employed for the research due to the quantum of vital information gained by the latter.

3.1. Approach to research and methods

There are basically two approaches to scientific investigations; namely, deductive approach and inductive approach to research. It is also known that the nature of the research topic determines which approach is most suitable. A clear and brief understanding of these two main approaches is discussed to clarify the main differences that exist. Accordingly, Deborah explains that the main distinction in the two approaches is that while a deductive approach analysis a theory, an inductive approach rather seeks to create a new theory from the experiment data (Gabriel, 2013).

3.1.1. Deductive approach

The Merriam-webster defines deductive approach as *"a method of reasoning by which (1) concrete applications or consequences are deducted from general principles or (2) theorems are deduced from definitions and postulates."*

Figure 10 below describes the processes employed in the deductive approach to research. In this case, the research starts with an established theory. A theory by dictionary definition is a system of ideas with the intention to disclose by explanation usually based on general principles independent of the subject to be explained. The next stage of the deductive approach is hypothesis; also defined as proposed explanation made on the grounds of limited evidence at the beginning for further examination to explain the manifestation of phenomena. Thirdly, didacticism observes the occurrences of the proposed or disclosed phenomena and finally a confirmation or rejection of the said theory. Accordingly, Gray explains that the deductive approach examines hypothesis and by this process it is either confirmed, refuted or modified. Usually, hypothesis is about assertions based on concepts that seek to explain the relationship that exists. In that, these concepts which are abstract ideas or better still philosophical conceptions form the genesis of hypothesis and theories. The first step is creating principles or opinion that is then tested through empirical observation. However, to confirm the feasibility of an underlying concept, it should be measurable and viable. The result is creating measures and indicators (Gray, 2004).Usually, depending on the scope of the research, the researcher approaches the task inductively or by a deductive manner. While the inductive approach is toward discovery of a binding principle and building up ideas as by figure 11; in observation, generalization and then theory, the deductive method is toward developing, applying, and testing it. Thus deductive method begins with the theory before proceeding to observation to buttress or question the said theory as elaborated in figure 10.
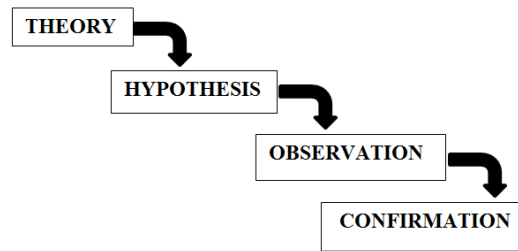
Figure 10. Deductive approach to research**;** (Trochim , 2006)

3.1.2. Inductive approach to research.

An inductive approach to research is the reverse sequence or procedure used in deductive approach. Figure 11 below gives a clear view of the process. Its use is chiefly in researching new theories emerging from a data. Research questions are used to narrow the extent of the study by observations which progresses from the data collected to theory. In other words, it is derived from specific information to a general idea.
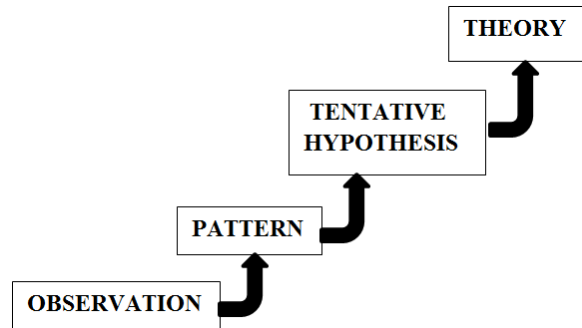
Figure 11. Process of inductive approach to research; (Trochim , 2006)**.**

The two approaches that can be employed in the observation of qualitative data resources are: - *Field source* and *Literature sources*. The field source involves non structured observation, interviews, case analysis, opening questionnaire, etc. Literature sources however entails observation from relevant research materials in the form of thesis, articles in periodicals, journals, portfolio, dairies and texts in the extended form (Merrian

2009:203). Having a desire, for first-hand information and interaction with those who matter, therefore a field source approach is employed.

3.1.3 Qualitative and Quantitative research methods

There has been a lot of contention between the pros and cons of qualitative and quantitative research methods. However, inasmuch as both methods are applicable in virtually all research contexts and investigations, the hassle becomes superfluous. Qualitative methods of research are usually designed for the observation of human behavioral factors and the social context of their environment. It involves studying man's perception of his situation and attitudes and conducts. Therefore it seeks people's interpretation of any subject in the social context.

The critical difference between qualitative and quantitative data is that while qualitative data is in verbal or visual format, quantitative data sets are in numbers. Some recognized characteristics of qualitative data explains why and how, not just what or when. The comparison can be seen detailed in table 4 below. Qualitative data are more flexible as it is based on methods of data generation. Consequently, it provides a means of data analysis and explanation that involves understanding complex situations in a detailed and context manner. Therefore qualitative research produces holistic understanding of rich, contextual and detailed data (Manson, 2002, ss. 1-4). A requirement as demanded by the topic of this study.

Quantitative research is defined as *"a formal, objective, systematic process in which numerical data are used to obtain information about the world*.

This research method is used:
  a. *to describe variables;*
  b. *to examine relationships among variables;*
  c. *to determine cause-and-effect interactions between variables."*
      (Klopper, 2015).

Qualitative research is done chiefly by words and not with numbers as in quantitative research, there could therefore be multiple meanings implied by a statement of purpose. Its interpretation therefore might not be precise (Tewksbury, 2009). Serpentine solves this problem by restructuring some vital questions in the questionnaire to provide concrete understanding which buttresses answers to the questionnaire.

Qualitative research (interpretive)	Quantitative research (positivist)
Assumption is that variables are complex, interwoven, and difficult to measure	Assumption is that variables can be identified and relationships measured
Research purpose is to contextualize, understand, and interpret	Research purpose is to provide generalizations, cause explanations and predictions
May result in hypotheses and theory	Begins with hypotheses and theory
Researcher as the instrument	Uses formal instruments
Inductive	Deductive
Searches for patterns	Component analysis
Uses words and narrative to invoke meaning	Uses numerical indices to invoke meaning
Determines the "why" and "how"	Determines the "what"*

Table 3. Comparison of qualitative and quantitative research methods. Adapted from (Stuckey, 2013).

Significantly, qualitative data analysis methods are not different from the qualitative counterpart. An example is that the ground theory was designed to be suitable for both instances (Eisenhardt, 1989, pp. 534-537).

A case study mostly contains discussions and interactions; therefore it is more beneficial to engage in qualitative data collection method when dealing with case studies. Also, as in this case, 4 different plants are under investigation to analyze collectively the benefits of OHSAS and organizational learning, qualitative data collection becomes necessary and

most suitable. Both theories require extensive questions and interviews to reveal the situation at stake.

3.2. Data collection.

Extensive questionnaire by the serpentine 2.0 is the main tool employed in collecting data for the research. To buttress this means of achieving a true representation of the situation on the ground, interviews were conducted with some managers to analyze the company's *occupational health and safety* status as well as *knowledge creation* and learning. Interviews with some workers of all levels of the factory floor, managers and the country manager. Actively participating in most processes employed in the Vaasa factory and observations are also made: – Action research.

3.2.1. Exploratory interviews

Interview questions used were unstructured and formulated during discussions to suit the needs of the research. It was more of a dialogue due to the action nature of the objective which was to seek: - Management's commitment and interest in OHSAS implementation and the benefits so far achieved. The first meeting was with the health and safety manager of the research company. The second and third meetings were held jointly with the then country manager and the current and substantive plant manager of both Tampere and Vaasa plants. Discussions with factory floor workers were held interactively during their day to day activities. By this unstructured means, their normal, natural attitude towards the research question was noted. By this multiple research approach employed, trustworthiness of the data is achieved as Sapsford states that the research can only be valid if the collected data measure up to the author's claim from which a valid interpretation can be derived. Thus qualitative research has its strength in particularity rather than in a general context. In that qualitative research is not just to create a general point from findings of the said

context. In some instances however, results could be generalized to a wider extent (Sapsford *&* Jupp, 1996; Creswell, 2009, s. 193).

3.2.2. Serpentine 2.0 tool

Evolute analyzes the current reality to a perceived future goal of whatever issue is under investigation for a specific research plan chosen. Hence the second version of Serpentine as a safety analysis tool is designed to reveal the present and the perceived future levels of safety in terms of the environment, management responsibility, the availability of *personal protective equipment* (PPE), and the level of safety culture in an industrial context amongst other factors.

- **Design of Serpentine**

The Serpentine tool is designed from three well known models to analyze safety culture, organizational culture and organizational knowledge creation spiral. These models are namely,

   a. Schein's model for organizational culture (Schein, 2004); this factor on the difference between the internal psychological issues and external detectable circumstances (Porkka;Mäkinen;& Vanharanta, 2013, s. 2).
   b. Cooper's safety culture model (Cooper, 1998); this consists of personal psychological considerations and the external physical factors (Porkka et al.2013:2).
   c. Nonaka and Takeuchi's organizational knowledge creation model. It deals extensively with tacit and explicit knowledge creation through SECI spiral. (Nonaka & Takeuchi, 1995).

The model upon which Serpentine 2.0 safety culture is designed is shown below in figure 12. The diagram is built on the analysis of both *internal psychological factors* (colored blue) and *external observable factors* (colored light green) as possessed by all three concepts being Cooper's, Schein's and Nonaka and Takeuchi's models (Porkka

2013). The bold writings of JOB, ORGANIZATION and PERSON represent Cooper's model where these three are external observable factors that Nonaka also calls externalization, combination and internalization section of the spiral (colored deep green). Obviously, PERSON is an internal psychological factor that agrees and coincides to internalization, socialization and externalization sections of Nonaka's spiral (colored deep blue). Serpentine is designed to reveal the safety culture/climate and the enabling factors prevalent in the organization. Accordingly, the changes that occur internally (PERSON) are based on the organizations ability to inculcate knowledge creation.
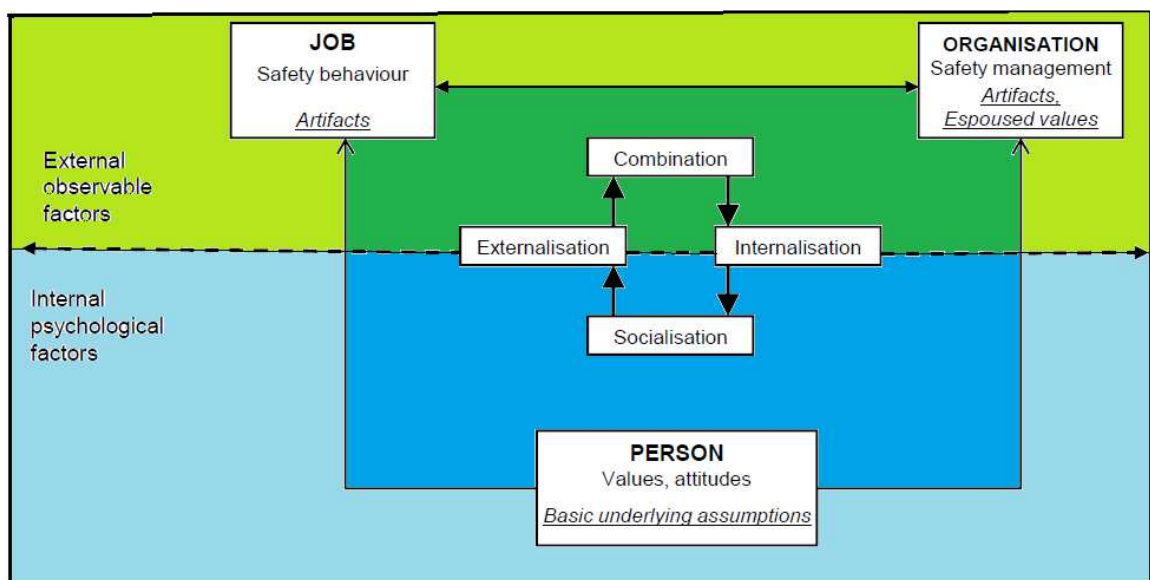
Figure 12. Serpentine safety culture model (Porkka;Mäkinen;& Vanharanta, 2013)**.**

- **Safety culture ontology**

The above serpentine model was used to create the specification of this concept.-safety culture ontology. The tool contains 51 questions derived from 17 concepts in total (Table 4). Significantly, the generated questionnaire is based on this conceptualization of safety domain and learning in organizational context. − Serpentine was developed by the

extensive work and analysis of a team of researchers at the Tampere University of Technology, Pori, Finland (Porkka et al. 2013).

By this research tool, the impact of the obligatory safety training received by workers, the level of support given to safety prioritization and if any encouragement is attributed to the practice to promote the concept of safety within the workplace are explored. Other factors are the awareness individuals possess towards safety in recognition of worker consciousness and how much responsibility is given to employee's vulnerability. The safety attitudes of workers, management and leaders role in this venture are likewise scrutinized. Besides, Serpentine investigates the organization's policy as a commitment to the protection of workers in the presence of flammable and hazardous liquids and gases, high voltages, heavy metals and constant movement of automated systems as most suitable for the case in consideration. Furthermore, it accesses the effectiveness of the safety policy implemented and the availability of the needed resources for safety. An impressive feature of serpentine is its capability in evaluating creative tension for each question. This evaluation of this difference between the current reality and the desired target of each factor is necessary due to the fact that a measurement of the current state of affairs only does not necessarily explain how much improvement can be made by the respondent's perception. Creative tension also shows if the respondent has any desire to improve the said factor in question. A zero percent tolerance for accidents and near misses has been the goal of many organizations within high risks environment. It accesses this simultaneously. Another outstanding component of Serpentine and Evolute in general is the statistical analytical software integrated into the model. Likewise, statistical requirement like the minimum standard deviation (MSD) that considers the differences between the values (Porkka;Mäkinen;& Vanharanta, 2013; Kantola, 2015, ss. 30-34).

No.	CONCEPT	DESCRIPTION
1	Safety Training	Mandatory safety training on working methods
2	Support and Encouragement	Promotion, approval, stimulation and assistance to ideas
3	Safety awareness and responsibility	Consciousness and accountability to prevent hurting or being hurt.
4	Safety attitudes	Response towards a safety idea, plan, procedure, goal, situation or prevention.
5	Leadership	Spearheading safety and knowledge creation.
6	Safety policy	A recognized written statement that states an organization's commitment to the protection of the health and safety of the employees,
7	Management	Management's commitment to safety
8	Working environment	The Work areas or facilities, is free of dangers that could cause harm to a person working in those areas.
9	Organization's openness to new ideas	A learning organizations culture
10	Atmosphere	Flammable and harmful gases
11	Efficacy of the safety actions	Ensuring optimal effectiveness in the safety policy
12	Resourcing of safety	Finding and providing the material, money or people needed for safety at the work place.
13	Co-operation	mutually beneficial goal in promoting organizational growth
14	Safety directions and regulations	Promoting zero tolerance for accidents and near misses.
15	Flow of information	Interactions and knowledge sharing within workers.
16	Creating new knowledge	Formation of new ideas through interactions between explicit and tacit knowledge in individual human minds (dictionary)
17	Learning by doing	Encouraging organizational learning.

Table 4. The 17 concepts used in Serpentine 2.0; Adapted from (Evolute , 2003-2015).

With a design of fuzzy logic which is the specific logic of unspecific things (Zadeh, 1965; Zadeh, 1994). The relationship between two distinct notions in the level of safety and learning within the framework of the research can be determined. Therefore fuzzy notion can be quantified and visualized. This system of assessment is used throughout the 33 projects of the Evolute system of evaluation. The beauty of the Evolute system is that by the use of fuzzification it is able to relate the illusory, hypothetical and vague nature of a perception without numerical conversion scales: - fuzzy logic (Kantola, 2015, ss. 43-46)

- **Fuzzy Logic Controller:**

Four dimensions of fuzzy logic controller employed are:-

a. **Fuzzification:** It is a mapping from an input crisp/conventional universe of discourse into the fuzzy interval (0, 1) that describes the membership of the fuzzy input variable (Ayoub & Ansari, 2015, ss. 33-35).

b. **Defuzzification:** This is the reverse mapping from the fuzzy to the crisp domain.

c. **Fuzzy rules:** It is defined in the context of a statement based on a condition of the pattern: IF X is R, and y is G. Where x and y are grammatical expressions. In other words, fuzzy rules are linguistic variables that are determined by fuzzy sets (Negnevitsky, 2005, s. 114).

d. **Fuzzy inference**: Fuzzy rules are used to develop the input of linguistic terms or variables and then resolve a feedback for the input. (Kantola, 2015, ss. 43-45).

As a web based questionnaire, an alias account is created for each participants to fill out the questions based on what the individual envisages to be the situation and aspirations of workers at the said organization. The collective responses of the investigation provide an answer to the state of the organizations safety culture. Conversely, the levels can be analyzed easily but critically for the needed action by management. A unique feature of Evolute is the capability of presenting a pictorial graph of answers to each respondent even before answers are collated. Included is the standard deviation of the current state to the targeted state of these 17 concepts in table 4. Other statistical variable displayed by Evolute is the variance. Pie charts and bar charts of the targeted state, current state, proactive vision and the Evolute index of all answers of a respondent. These are likewise accessible. Since safety and knowledge creation is always a factor to be improved based on an existing situation, as in this investigation, management's commitment becomes prime to its success (Cox & Cox, 2007). For this reason, four managers of the company were involved in the data collection and two were interviewed as well.

3.2.3. Action research

Action research in an organizational context can be defined as a process whereby a researcher or group of researchers are actively involved in the activities of the said organization in order to improve the goal or vision of the organization by interactively collecting data, interviewing and observing. Implying that in action research, there is a close collaboration or participation of the researcher to the question at stack. It places emphasis on the promotion of work patens and processes. While this emphasis is usually about searching for clues on attitudes and mannerisms towards work, data collection might possibly involve both quantitative and qualitative methods. (Winter & Munn-Giddings, 2002, ss. 5,23; Gray, 2004, s. 31) One main advantage is that the researcher gets the opportunity to realize the way most people behave as well as the natural rhythm that things occur in an organization. Due to the fact that action research is always about working towards a positive impact on the work of an organization, the truth behind the answers of most questionnaires where people usually give appropriate response rather than what actually happens would be seen. Another advantage gained in this process and by this studies is that the respondents and interviewees were aware the researcher knew the situation on the ground. Thus an incorrect answer could be instantly realized as untruth. Winter further laments that because *action research* mainly occurs in a case study, the gap between theory and practice is inevitably bridged.

3.3. Project Company

Bodycote was established in 1923 by Arthur Bodycote initially as a textile business under the name G.R. Bodycote Ltd in Macclesfield, United Kingdom. It later moved into heat treatment and currently, it is the world's leading supplier of thermal processes. The company is presently located in 24 countries with 190 operational plants (Bodycote International PLC a, 2014). In Finland, it employs a total of 64 workers. Bodycote

improves the properties of metals and alloys by heat treatment, metal joining, surface technology and *Hot Isostatic Pressing* (HIP) thereby extending the life of vital components for a wide range of industries. This includes aerospace, defense, automotive, power generation, construction, and medical and industries. Operations in and around Vaasa are mainly:- case hardening of heavy diesel engine parts, aluminum hardening, annealing - *softening*, tempering *toughening* likewise testing the depth of hardness of treated camshafts, piston pins and piston taps. Bodycote also undertakes gas nitriding and induction hardening of specific sections of machines for many other applications most of which is geared towards energy production.

The company is internationally recognized for heat treatments, metallurgical coating and testing services. It is accredited with ISO 9001:2000, ISO 14001:2004 - *International Standards Organization for quality management and environmental management* respectively, AS 9100B - *Aerospace Sector Standard certification* and OHSAS 18001:2007 (Bodycote International PLC b, 2015). In addition, it has numerous international quality accreditations and a number of customer approvals.

The company's statement of purpose is quality of work and timelines in its operations. Its customers range from giant multinational corporations like Caterpillar Incorporated to individuals. The Finnish headquarters is located in Vantaa. Bodycote Finland's main customers include Mapromec Oy, Finn-Bolt, Finn-Power, Wärstilä, Moventas Wind, Taso Wheel Oy, etc.

3.3.1. Commitments to health and Safety

About Bodycote's commitment to zero tolerance for accidents, it states that it "*works tirelessly to reduce workplace accidents and is committed to providing a safe environment for everyone who works at or visits our locations. The accident frequency rate has decreased to 1.7 in the year (2013: 1.9)*". (Bodycote International PLC b, 2015).

Accident frequency is defined as *"the number of lost time accidents × 200,000 hours (approximately 100 man years), divided by the total number of employee hours worked"*. Bodycote's statistics on carbon footprint which is also defined as the quantity of carbon emissions in tones of CO_2 divided by £m revenue. These calculations of the specific CO_2 emissions are in connection to the use of electricity and gas in kilowatt hours multiplied by each country's definitive conversion factor. Figure 14 shows these values for the corresponding years. Bodycote's total revenue in 2014 stood at £609.1million with a return on capital employed at 20.7% (Bodycote International PLC b, 2015).

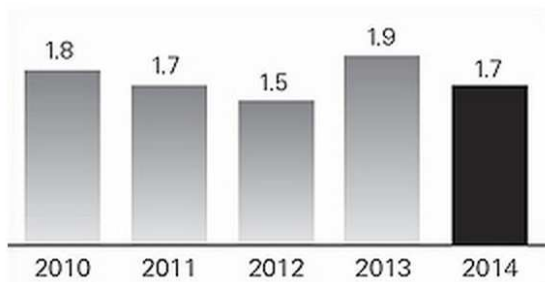**Accident frequency**

(number)

Figure 13. Accident frequency by numbers: (Bodycote International PLC b, 2015)

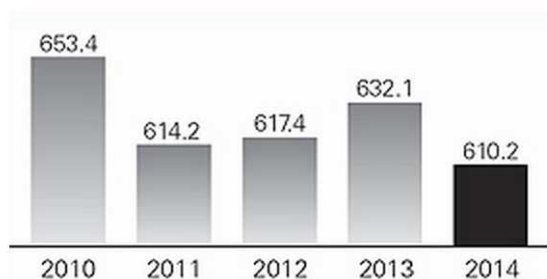**Carbon footprint**

(tonne CO_2e/£m sales)

Figure 14. Carbon footprint: Adapted from (Bodycote International PLC b, 2015)**.**

The nature of heat treatment is such that workers are inevitably exposed to hazards at the workplace. However, through the deployment of a robust safety control systems and procedures, as in safety standards and building an active safety culture, these hazards can be managed and the threats minimized or possibly removed. Bodycote aims to manage these hazards and thereby minimize risks to employees. On the frequency of accidents annual global report since 2010, the graph in figure 13 showed a decrease until 2013. This is due to the fact that in 2013, Bodycote introduced an online incident reporting and management tool which facilitated a detailed, more dependable and thorough reporting of occupational injuries, unsafe conditions and near misses. By reason of this, there was an increase in the lost time injury rate frequency (LTI rate) in 2013 as it provided a better means of reporting and recording of incidents. Accordingly, the LTI rate in 2014 dropped to 1.7 as seen in figure 13. Thereby it established an improvement in occupational related injury reporting which although regrettable and not acceptable, paves way for learning. It also shows that accurate and active reporting system employed in any organization would buttress an essential part of building a powerful health and safety management system.

Additionally, an essential part of this reportage is the documentation of near misses and unsafe conditions. This enhanced reporting of incidents permits potential health and injury hazards being tackled appropriately. Similarly, it ensures that preventive actions are taken before any eventuality occurs. It also shows that as the database continues to develop; there would be better analysis and prioritization of safety action programs. Furthermore, it enables the executive management team to better analyze incidents which not only resulted in injury but had the potential to cause injury or ill health (Bodycote International PLC a, 2014).

4.0. RESULTS AND SUGGESTIONS

Results of collated data of the questionnaire and the subsequent analysis are presented in the form of charts and graphs in this chapter. Suggestions are also given while reflecting on the theories used in this research. The objective is to discover employee and management perception of the level of occupational health, safety and the prevalence of organizational learning amidst numerous company accreditations and certifications in this concern. Information gathered through discussions and interviews are also analyzed. These results as previously mentioned are based on questions that range from the flow of information, socialization, safety directions with regulations and working environment. Other answers such as knowledge creation and cooperation amongst staff are likewise statistically and pictorially presented.

4.1. Serpentine questionnaire evaluation

From the 20 employees targeted to answer the web-based questionnaire, 16 responded. This gives us 80% response rate and the survey can therefore be considered to be dependable. Majority of the answers were received within three weeks but the total period of data collection spans from the 26th of May to August 8th, 2015. Identities of all respondents are kept intact for obvious reasons. Answers from all respondents form a complete equal ranking of all 16 respondents.

Most respondents had no problem with understanding since Evolute questions are simplified and multilingual. There were only two instances where further clarification was sought out. Again, the reliability of the results is heightened by the low values of standard deviation obtained for both the current and targeted states as seen in figure 15. Meaning that, the choice of the individual results had a high level of similarity. Implications are that the collated results are reliable and a true representation of individual perceptions of raised

issues. This is buttressed by the values of the variance for both current and targeted states of all 17 concepts discussed in chapter 3. Generally, the main categories from the total of the various concepts of figures 16 to 18 look promising. Howbeit, a breakdown shows some aspects that need strategic management decisions and programs to ensure the company's sustenance of its competitive advantage.

4.2. Statistical outcome.

Arranging the 17 concepts yields the statistical results tabulated in figure 15 below. The median values of both current and targeted states are listed starting from safety training having a value of 0.5 to controlling of risks at 0.451. Respective values of these variables follow through to the variance of the targeted state of 0.018 and 0.039. In as much as *safety awareness and responsibility* has the highest ranking, it needs to be upheld. Even though the total results show a positive value of above average, because safety is targeted at zero percent tolerance for accidents, much is required from the current state to targeted values.

Class_name	Median_c	Median_t	Average_c	Average_t	Standard_dev_c	Standard_dev_t	Variance_c	Varianc
Safety training	0.5	0.5	0.86	0.929	0.25	0.133	0.062	0.018
Safety directions and regulations	0.391	0.5	0.772	0.891	0.244	0.173	0.059	0.03
Learning by doing	0.393	0.5	0.7	0.871	0.282	0.145	0.08	0.021
Co-operation	0.366	0.486	0.669	0.827	0.242	0.197	0.059	0.039
Working environment	0.366	0.475	0.644	0.858	0.259	0.179	0.067	0.032
Management	0.413	0.5	0.755	0.92	0.313	0.172	0.098	0.03
Support and encouragement	0.336	0.376	0.588	0.767	0.257	0.2	0.066	0.04
Safety policy	0.441	0.481	0.809	0.891	0.244	0.154	0.059	0.024
Organisation's openness to new ideas	0.38	0.5	0.739	0.875	0.286	0.226	0.082	0.051
Atmosphere	0.348	0.463	0.616	0.838	0.273	0.17	0.074	0.029
Efficacy of the safety actions	0.366	0.5	0.759	0.927	0.244	0.113	0.059	0.013
Resourcing for safety	0.382	0.479	0.655	0.805	0.314	0.234	0.099	0.055
Safety awareness and responsibility	0.5	0.5	0.883	0.943	0.21	0.139	0.044	0.019
Safety attitudes	0.41	0.5	0.838	0.906	0.143	0.18	0.021	0.033
Creating new knowledge	0.366	0.366	0.631	0.749	0.244	0.222	0.06	0.049
Flow of information	0.377	0.5	0.748	0.844	0.295	0.255	0.087	0.065
Controlling of risks	0.451	0.5	0.794	0.907	0.246	0.198	0.061	0.039

Figure 15. Statistical outcome of the results (Generated by the Evolute Research Tool).

Median and average values for the current and targeted states are indicated throughout. Included are other statistical variables. Cumulatively, the highest value of averages of the current state is found to be for the concept; - *safety awareness and responsibility.* This has *a* value of 0.883 (88.3%) with an obvious larger value of 0.943 (94.3) for its targeted state. Meanwhile the lowest mean obtained is 0.588 (58.8%) for support and encouragement. The lowest mean for the targeted state was found to be for the concept:- *creating new knowledge* with a value of 0.749. Subsequent values of standard deviation and its variances of both current and targeted states for all concepts under investigation can be seen below. Details of these values are pictorially represented in figures 15 to 18. The color blue throughout represents the current state and red the targeted state of collated results.

4.3. Current state.

Figure 16 below present's results obtained of the current state/levels of the safety culture and knowledge creation ontology as embedded in organizational learning and *Occupational Health and Safety*. As can be seen, these results of the current state (blue) are sorted in descending order.
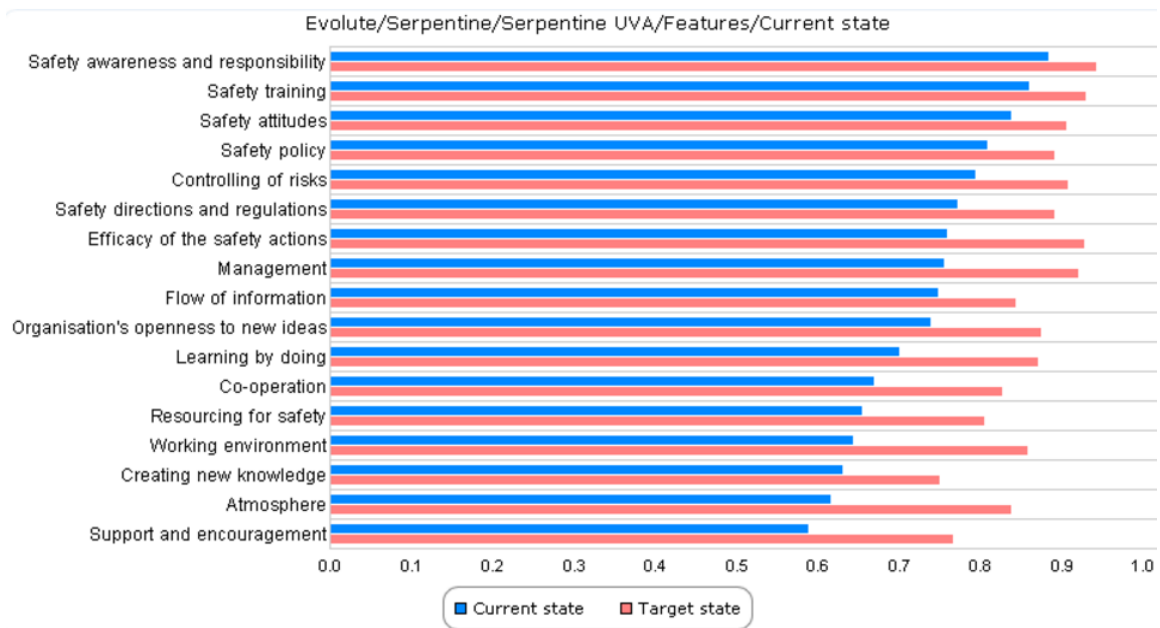
Figure 16. Current state of affairs sorted in descending order (Generated by the Evolute).

As seen under these statistical values, highest in ranking of the current category is *safety awareness and responsibility*. Invariably, it a positive trend of personal consciousness and obligation to safety. This is visible by the red mark closest to the boundary in figure 17. Perception to *safety training* and *safety attitudes* follows this trend in a clockwise direction. Last on the list is *support and encouragement*. Last but one is *Atmosphere*. The *working environment* as referred here is the work surroundings and the safety of workers in relation to constant management interest in improvement.

4.4. Targeted state.

By answering the research questions for the desired objective (target) of each of the concepts, the red heptadecagonal shape is automatically drawn for each respondent. The answers are likewise arrainged in descending order.
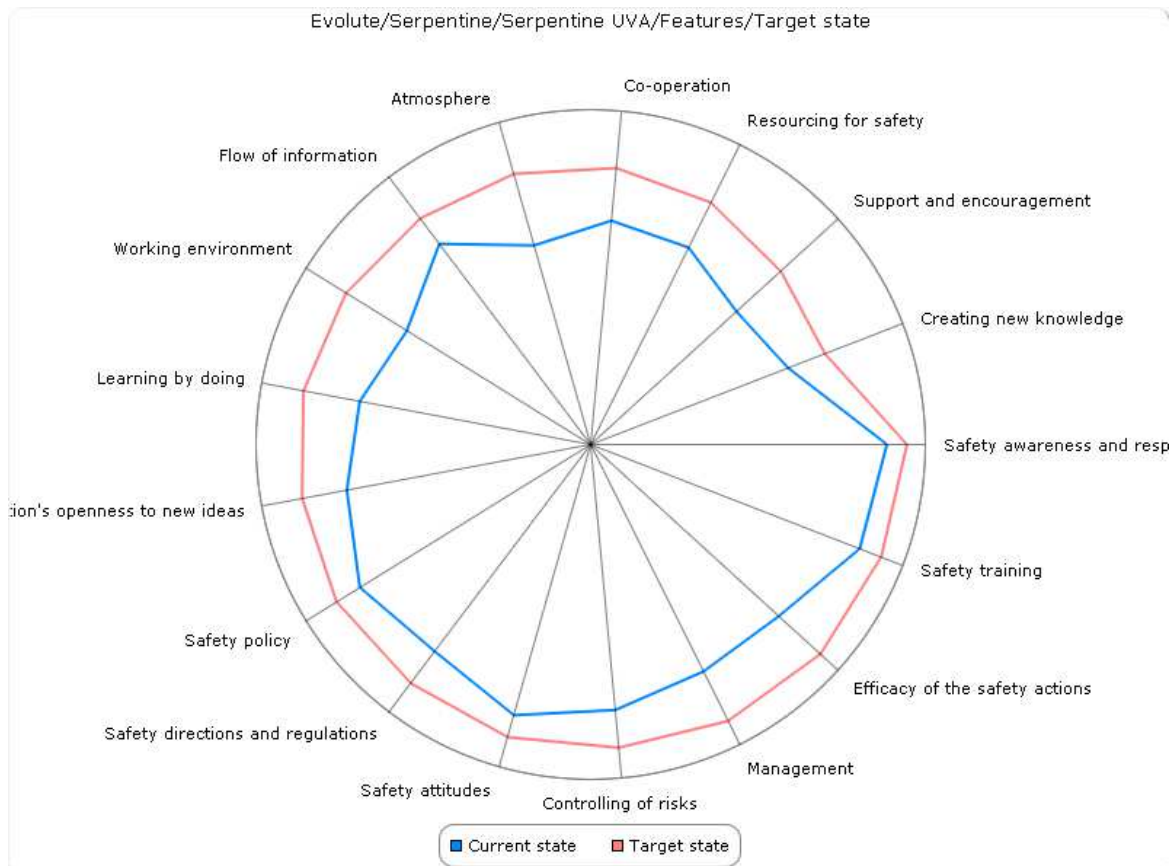
Figure 17. Desired targeted state of the 17 concepts (Evolute generated).

Lowest in the target is seen as ***creating new knowledge***. Although the above values indicate a positive trend of affairs, it is particularly worrying that knowledge creation should be seen lowest in both current and targeted states. A disturbing scenario; Could this be due to the perception that heat treatment has been in existence since the *Iron Age* and therefore not much can be done to achieve any further improvement?

4.5. Combined results

The heptadecagon created above which is derived form answers of the 51 questions of Serpentine 2.0 are further simplified into 8 notions that forms the octagonal in figure 18 below. This subdivion is then appropriated to the SECI concepts of the *knowledge creation spiral* for organizational learning and OH&S analysis. Herin the relationship between both theories are analyzed concurrently.

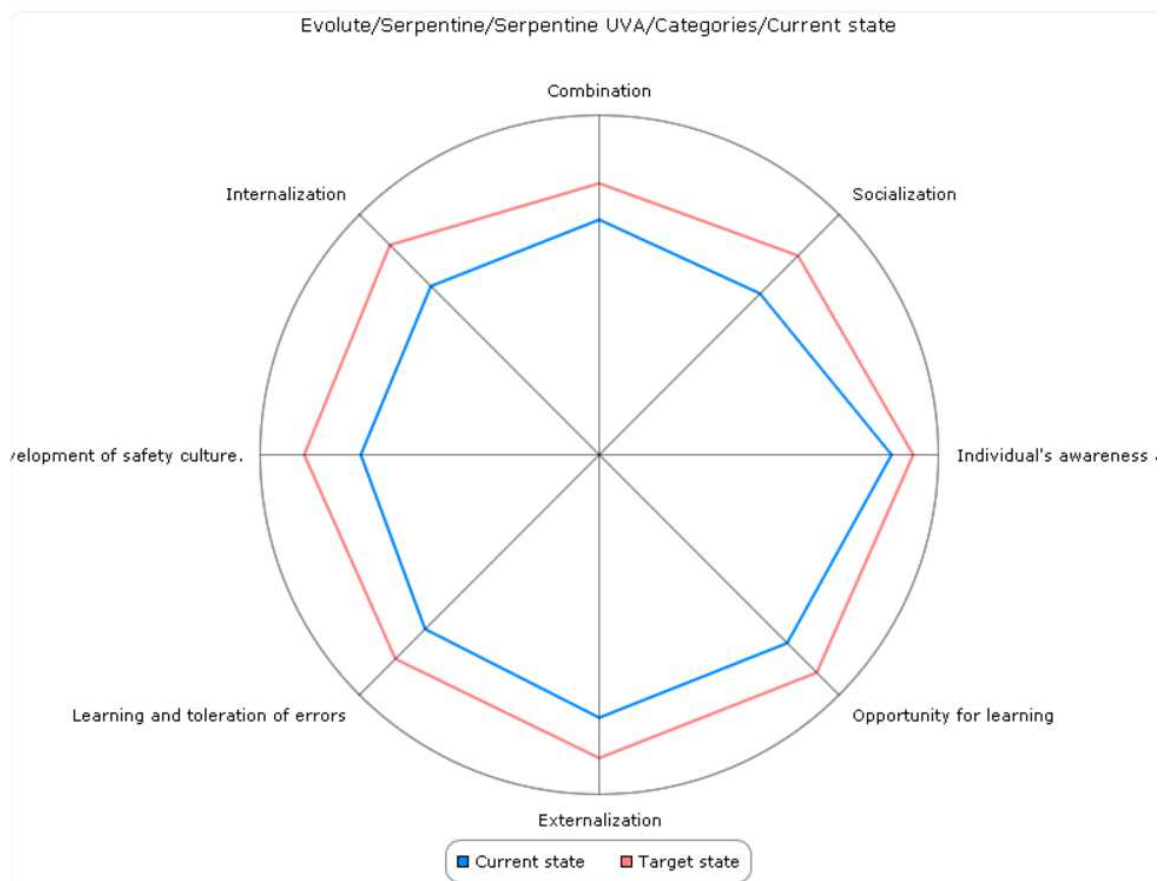**Figure 18.** Chart of current state categorized (Evolute generated).

These 8 factors are listed below; the above chart shows the blue octagon being the current state of concepts categorized and red the targeted state to visualize the amount of room that exists for improvement – creative tension. Analyzing the concepts illustrated in the chart clock-wisely from the first quadrant are: -

- o *Individual awareness and responsibility.*
- o *Opportunity for learning.*
- o *Externalization.*
- o *Learning and toleration of errors.*
- o *Development of safety culture.*
- o *Internalization.*
- o *Combination.*
- o *Socialization.*

Under this categorization, the concept of ***Individual awareness and responsibility*** has the highest ranking as can be seen to be closest to the circle which starts from the horizontal line; X- axis in the first quadrant. ***Socialization*** on the other hand is likewise seen to be lowest in value. This; according to discussed theories of ***knowledge creation*** are needed to spread tacit knowledge interpersonally and in this case amongst employees. A lack of ***socialization*** ultimately results in the widening of competence limitation and the creation of a generation gap within the organization. The next affected factor that follows is ***Combination. Combination*** as explained is the distribution of explicit knowledge as in documents, data bases and electronic formats. Interestingly enough, the learning spiral is adversely affected when ***Combination*** within the spiral is lacking. Relatively, new as well as updated manuals and documents about improved processes and methods in the plants needs to be shared to operators and interested persons. As ***combination*** in this sense is improved, the knowledge spiral continues unabated.

In that the role socialization plays in occupational competence by collective knowledge disbursement and acquisition are numerous. In this concern, creating programs that can generate a culture of openness and interaction would benefit the company immensely. By observation, the culture so far has just been as in an assignment problem, where each

employee is assigned to a specific task and only the said worker has to accomplish it. This exclusive allocation of responsibilities to specific people for decades has automatically created that individualism of responsibility and widened the socialization gap.

4.6. Observations and suggestions

Safety training has mostly been under the auspices of external professionals. This is quite structured and sometimes too broad. Having seminars with experienced employees to illustrate perceived or prevalent risk factors with relevant training could be more effective to sustaining health and safety levels of specific plants. Efficiency in this regard could be improved by designing training to be appropriated to the actual task of workers. Training arrangements have also been too generic rather than specializing on the specific task in thermal processing. Ultimately, skill building by requisite knowledge increase would boost organizational core competences building.

4.7. Interviews and interactions

During a face-to-face interview with two managers, the following dialogues enshroud. Even though interviews were unstructured enough information as required was received.

- In answer to the structure of OHSAS as employed in the four plants, the SHE manager stated that:-

Working safety and requirements are defined locally due to the fact that work environment settings and processes are different for all companies.

The safety system is created and managed with responsibilities of the highest personal. This is in the order:

1. *Country manager.*
2. *SHE manager.*
3. *Local managers.*
4. *Safety delegates.*

Audits of the SHE system are done annually. The SHE manual contains all the documentation of work, practices and safety policies. It also contains material safety data sheet, risk assessment, external audits, safety audits, and accessories such as an active fire/gas alarm system. The SHE folder is located in the M-files which are available to all required persons.

- What special features are embodied in OHSAS standard?

Work and safety measures are now critically evaluated. Special procedure during services and maintenance like lockout-tag out that prevents accidental operation of machinery during services are used. Others are gas sensor for confined space work and gas alarm systems. These sensors indicate oxygen levels in work environment. *This also includes instructions for isolation of confined space, monitoring and procedure. The OHSAS standard accreditation has been under the supervision and regulation of the Finnish Accreditation Service – FINAS. This is in collaboration with Bureau Veritas Certification Finland.*

- The Tampere/Vaasa plant manager explained further that:-

The structure also includes yearly audits by Bureau Veritas. Others are planning for risk assessment; due to the higher level of the OHSAS standard, it has been used by Bodycote as the mandatory requirement for OH&S.

That Bodycote's safety policy due to OHSAS is higher than that specified by the Finnish Institute of Occupational safety and Health Act.

- In answer to training and awareness of workers and visitors, the SHE manager explained that:-

These measures (enshrined in the OHSAS document) *leads to all staff members being trained extensively and periodically in safety measures and in hot work. Process of handling changes in operation or procedure are all carried out with safety concerns being foremost in consideration. It has also provided us with a feedback system. Safety training includes but not limited to; - How to handle an emergency situation, specific safety codes, risk prevention etc. Personal Protective Equipment (PPE) for all workers including contractors and visitors are also provided. Work instructions are therefore given with regard to the knowledge levels of personnel in relation to safety requirements.*

- During the discussion, both managers explained that the OHSAS structure provided regulation for all procedures including planning towards achieving a zero % tolerance for accidents and injuries.

That risk assessment has been carried out more frequently:-The recognition of dangerous operations, hazardous situations and conditions. To achieve this, a tour of the entire facility is organized periodically. This Safety tour includes to a 5S tour that likewise plays a pivotal role in environmental safety issues.

- What factors prompted the acquisition of such a high standard of safety?

That previously, before OHSAS in 2007; some requirements were needed which are contained in the OHSAS standard. Upon auditing by Bureau Veritas Certification, It was requested to have in place some of these tools embedded in the OHSAS standard. This made it necessary to push for such a rigorous OHS policy.

- Asked about the benefits so far achieved:-

The clearest benefits are a drastic reduction of minor injuries as well as workers absenteeism due to ill health. By the subsequent introduction of SHE policy, accidents, potential risks and near misses are all recorded in a database that are reviewed periodically. Workplace accidents have likewise reduced.

Due to OHSAS accreditation, our customers are more confident in dealing with us as we have shown compliance to statutory legal and regulatory occupational health and safety requirements. This helps in maintaining a zero tolerance policy to minimize or possibly completely eliminate any environmental effects.

- Having such a standard for any firm with different locations streamlines regulations and requirements as countries have several diverse legal jurisdictions. The standard also provides a framework that could be used to monitor and measure OHS.

One great advantage has been the continuous improvement structure of OHSAS standard. This makes the work to become better and better in occupational health care and safety work place environment with the obvious economic benefits.

Bodycote's health policy of workers also exceeds legal requirements. In that, apart from having paid health care, workers at the Vaasa plant attend checkup once in three years and twice a week attendance to the gymnasium. This ensures that employees are toughly fit. Benefits are improved mental awareness, cardiovascular fitness and general body fitness. Moreover, waist or low back pains that factory workers generally experience from time to time are minimized. Emphasis is that health care plays a direct role in absenteeism reduction. Bodycote employs a fully integrated system of the OHSAS standard as an option in the theory part (chapter 2.1.7.) of the OHSAS document. Personally, the writer recollects being trained seven times in various occupational health and safety issues throughout his period of work.

5.0. CONCLUSIONS

It is now abundantly clear the importance health and know-how of employees play in the prospects of organizations. In that, productivity benefits are realized by the employment of a rigorous health and safety standard. That, by incorporating continuously the knowledge creation spiral; a firm's fortunes blossom. Basically, the research involved OHSAS 18001:2007 theory with the knowledge creation spiral. Specifically investigations and subsequent suggestions into core competences building with required knowledge management within workforce.

Although results from data collected shows a positive trend of OH&S, due to the factor - *socialization* amongst workers seen to be lowest in ranking in the collated results; just as knowledge creation was also seen to be low, it is needful that management work towards integrating cooperation by combined responsibilities which would likewise boost on the job learning and interaction. This can be achieved by the model of knowledge creation process explained earlier in chapter 2.2.6 by figure 8. It is hoped that by integrating these measures, interpersonal relations would automatically increase interaction which is necessary for the flow of tacit knowledge to increase learning and competency building. Complementary to this, it has been realized through observation and interaction that the rigorous health and safety management system employed has truly yielded positive results. Notwithstanding, the level of OH&S can be further improved by building a safety culture initiative through interactive and sustainable programs.

Having formal programs for discussions and learning from others, especially working together with the highly experienced would eventually increase internal company information disbursement that supports learning between workers and ultimately pave way for expertise creation. Furthermore, both theories emphasize the importance of planning; and as realized from the empirical results, highlights of team meetings for fruitful and helpful discussions for learning and interactive reflections are needed. The difficulty in this regard is the change of the traditionally emphasized monopolistic attitude of workers. It is

also needful to state that learning should not be limited to new products and methods but reviewing traditional production methods that require improvement. Just as mentioned in the other areas that require improvements, management interest, support and initiative is needed. Short causes in line with specific role of workers are other areas that can be encouraged. Such studies can particularly be useful if the program structure is not too broad.

- **Future research possibilities.**

Due to the constraints that limited this research mentioned earlier in (chapter 1.2); as the research was carried out in only four thermal processing plants and not in other areas of industry, further studies could be considered that would widen the horizon. Other drawbacks like limiting the research to only internal company policies can equally be considered for broadening. Another issue that would also make further studies necessary is that in the current dispensation, the researcher also as a worker might have overlooked some factors that an outsider could have noticed. Additionally, as a staff, the researcher could have been too much engrossed with company enhancement due to obvious interests as an employee.

Conclusively, this research has empirically discovered some inadequacies within the knowledge base transferee. Some of the development methods discussed in the theory part like group tasking with the use of appropriate methods to rectify the prevailing individualistic culture have also been suggested. Theoretically, these are analyzed to systematize the link of both factors of workers wellbeing to their output. Findings show that by implementing a rigorous OH&S management system - OHSAS 18001:2007; the level of employee absenteeism and loss of man hours subsequently decreased substantially. Other benefits have been the company's image enhancement.

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APPENDICES

APPENDIX 1. Serpentine Questions**:**

Valitse vaihtoehdoista se joka parhaiten vastaa mielipiteeseesi asiasta, alla olevan esimerkin mukaan.

1. Laatu on hyvin tarkeä tekijä toimittajaa valitessa
2. Kustannukset ovat suhteessa toimittajan tuotteiden laatuun
3. Toimittajan kanssa on mahdollisuus sopia kustannuksista ja neuvotella niistä
4. Toimiminta on turvallista johtuen toimittajan maantieteellisesta sijainnista
5. Toimittajayhteistyössä on suuret riskit yrityksellemme
6. Toimittajalla on ollut vakavia maksuvaikeuksia kuluvana vuonna
7. Organisaatiossamme on turvallisuuteen liittyvä palkitsemiskäytäntö, joka on
8. Puutun toisten työskentelytapoihin, jos ne eivät ole turvallisia

9. Eniten voin estää tapaturmia huolellisuutta ja varovaisuutta noudattaen
10. Minulla on mahdollisuus osallistua ja vaikuttaa organisaatiomme turvallisuusasioihin
11. Organisaatiossamme turvallisuusasioihin kiinnitetään huomiota
12. Eriävän mielipiteen esittäminen organisaatiossani on
13. Huonot suhteet yhteistyökumppaneiden välillä ovat haitanneet turvallista työskentelyä.
14. Organisaatiossani toimivat henkilöt eivät halua jakaa tietojaan, koska pelkäävät toisten käyttävän niitä hyödykseen ja ottavan kunnian niistä omiin nimiinsä.
15. Saan tietoa työtehtävieni hoitamiseksi
16. Saan tarvittaessa myös sellaista tietoa, joka ei ole välttämätöntä työtehtävieni hoidon kannalta.
17. Organisaatiossani on työni kannalta hyödyllistä tietoa, mutta en tiedä, miten siihen pääsisi käsiksi.
18. Organisaationi mahdollistaa tekemällä oppimisen.
19. Organisaationi kykenee käsittelemään virhetilanteita sekä oppimaan niistä
20. Organisaatiossani hyväksi koettujen toimintatapojen leviäminen on:

21. Epäselvä tehtävänanto tai opastus on häirinnyt kykyäni työskennellä turvallisesti.
22. Riittämätön aika tarvittavan työn tekemiseen on häirinnyt kykyäni työskennellä turvallisesti.
23. Organisaatiossamme toimitaan siten, että muiden työntekijöiden tai ulkopuolisten ihmisten turvallisuus ei vaarannu.
24. Ymmärrän, miten oma panokseni vaikuttaa muiden työturvallisuuteen.
25. Organisaatiossamme toimitaan turvallisuusohjeiden ja -määräysten mukaisesti.
26. Työhön perehdyttämisen yhteydessä käsitellään turvallisuuteen liittyviä asioita
27. Esimiehet kannustavat turvalliseen työskentelyyn.
28. Turvallisuuteen liittyvissä asioissa esimiesteni tavoitettavuus on
29. Turvallisuuteen liittyviin kehitysehdotuksiin suhtaudutaan organisaatiossani myönteisesti.
30. Organisaatiossani johdon sitoutuminen turvallisuuteen on
31. Organisaatiossani huomioidaan työn stressaavuus ja henkilöstön ylikuormitttuminen.
32. Organisaatiossamme seurataan, että henkilöt kehittyvät ja oppivat ajan tasalla olevaa turvallisuustietoutta koko työuransa ajan.

33. Riittäviä ja asianmukaisia työn suorittamiseen tarvittavia suojaus- ja apuvälineitä on saatavillani.
34. Henkilökunnan puute on aiheuttanut työskentelyni turvallisuustason laskua.
35. Jokin työympäristössäni (esim. melu, kuumuus, kylmä, kosteus, pöly) on häirinnyt kykyäni työskennellä turvallisesti.
36. Työympäristöä tarkkaillaan ja sille tehdään korjauksia.
37. Olen tietoinen työhöni ja työympäristööni liittyvistä vaaroista
38. Tiedän miten onnettomuustilanteessa/vaaratilanteessa tulee toimia.
39. Ilmoitan esimiehelleni vaaratilanteista/turvallisuuspuutteista.
40. Rikon turvallisuusohjeita, jos se nopeuttaa työni suorittamista.
41. Organisaatiomme eri tasot ovat läheisessä kanssakäymisessä toistensa kanssa.
42. Työhöni liittyvistä asioista tiedotetaan
43. Organisaatiossani turvallisuusriskeistä puhutaan avoimesti.
44. Turvallisuusohjeet ovat helposti kaikkien saatavilla.
45. Turvallisuusohjeet ovat selkeät ja helposti ymmärrettävät.

46. Turvallisuusmääräysten noudattaminen on ristiriidassa normaalien työkäytäntöjen kanssa.
47. Turvallisuusohjeet päivitetään säännöllisesti.
48. Organisaatiossamme työntekijät auttavat toisiaan työskentelemään turvallisesti.
49. Olen selvillä organisaatiomme turvallisuuteen liittyvistä tavoitteista.
50. Organisaatiossamme yleinen siisteys / järjestys on
51. Työympäristön suunnittelussa huomioidaan ensisijaisesti turvallisuus.

APPENDIX 2. Evolute results of current/target states and standard deviation mark.