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# A Systematic Approach To Reducing And Predicting Human Error: Sherpa Is A Model

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## Abstract:

This paper aims to reveal one of the methods and approaches of research in ergonomics by presenting a systematic approach to reduce and predict human error, by determining its effectiveness in reducing and predicting human error.

This paper is a survey study of some ergonomic research and studies, which in turn dealt with the Sherpa method to reduce human error.

The research concluded that the Sherpa method is a typical and effective method to reduce and predict human error, and this method is suitable for all work centers, and is even more effective in the field of maintenance. This method also requires other methodological techniques in the application of its eight stages, such as the task hierarchical analysis technique.

**Keywords:** Ergonomic approach; human error; Sherpa method; field maintenance.

## Introduction

### 1- Study problem:

Human resources are considered one of the important and essential resources in the organization, as they provide the basis for the organization's performance, as they possess knowledge, skills and abilities that qualify them to perform their role as they should, and thus ensure the smooth running of the work process in the organization.

The performance of human resources is a real and clear indicator that reflects the performance of the general organization, as it is the criterion through which we can judge the effectiveness of the organization in performing its role, and from here this topic received our attention and it was necessary for us to try in the components and details of this topic.

There have been many studies that have addressed the performance of employees and have received the attention of many researchers, and most of these studies have focused on evaluating the performance of employees, considering that the evaluation process is a basic activity that takes a large part of the attention of officials, especially decision makers and takers.

The performance evaluation process is an important process practiced by management at all levels of the organization, starting from senior management to implementing employees. In order for this process to achieve the desired goals, it is necessary to deal with it in a scientific and accurate manner. Therefore, the performance evaluation process requires a comprehensive strategy and an accurate understanding of the organization's performance,

because the overall performance of the organization is the complete result and product of its work in light of its interaction with the elements of its internal and external structure.

Performance evaluation is a process that aims to develop and improve the performance of the organization in general and human resources in particular. The performance evaluation process includes all levels of the organization, since the continuous improvement process must include all areas and departments within the institution without exception. The performance evaluation process does not necessarily measure the senior positions of officials and department heads only, but it is a comprehensive process. We mention here in particular the maintenance department, which, to the researcher's knowledge, has not received sufficient attention in studies and research that addressed performance evaluation as a subject of study. Despite the scarcity of research in this regard, it was sufficient to be a starting point and theoretical support for important future studies.

The approaches and approaches to performance evaluation research have differed according to the researchers' orientations, starting points, and the angle from which they view it. For example, we find approaches of a sociological nature, and there are approaches of a psychological nature that are specialized in by psychological experts and researchers in the psychological field, as well as the ergonomic approach of a psychological-technical nature, which highlights its interest in the behavioral outcomes resulting from the interaction occurring in the system (human-machine). This approach attempts to include both the technical aspect of the machine and the psychological aspect of the worker within a single equation, and attempts to grasp all the data that may affect this system, as this survey study focuses on human error and how to predict it through an ergonomic methodological approach, which leads us to the following research questions:

## **2- Study Questions:**

- What is meant by the ergonomic systematic approach to reducing human error?
- What are human errors and what is the importance of studying them?
- What is the nature of the SHERPA method?
- How effective is the application of the SHERPA method in reducing and predicting human error?

## **3- Study Objectives:**

This study generally aims to define the ergonomic systematic approach using one of the well-known scientific methods "Sherpa" as it relies on a set of steps and techniques that we will try to explain in this paper, and under this general objective are several partial objectives that we present as follows:

- Determine what is meant by the ergonomic systematic approach to reducing human error?
- Defining human errors and what is the importance of studying them?
- Revealing the nature of the SHERPA method?
- Revealing how effective is the application of the SHERPA method in reducing and predicting human error?

## **4- Importance of the study:**

- The importance of this research lies primarily in that it reveals the nature of the SHERPA method, and the extent of its effectiveness in reducing and predicting human error.
- The importance of this research also lies in that it addresses the subject of performance evaluation and identifying human errors in the position of maintenance technician with an ergonomic aspect, as it includes various factors leading to failure in expected performance.

-Seeking to employ the methodology of detecting human error in the position of maintenance technician in order to enhance training, guidance and promotion procedures.

-Identifying human error contributes to identifying the characteristics of technological change.

-Identifying points of failure in an objective manner in order to intervene and provide effective solutions.

- Warning of the seriousness of performance failure and its consequences that affect the human element and equipment at the same time.

## **5- Controlling the concepts of the study:**

### **- Ergonomic methodological approach:**

When the researcher begins the research process, he focuses on the topic of his research, because it is the one that basically determines the structure of the research, its stages of formation and its objectives. Here comes at the beginning the methodological approach that will help him to scientifically approach his topic, and gradually encompass its elements. The approach must be clear because it determines the questions, perspectives and procedures that the researcher will use in his study. Maurice Angers (2006) defines: "The approach is a special, unconventional way of using theory" and when combined with the method, Angers defines it as "a special, unconventional way of using theory, strictly, and with a desire for organization. Ergonomic analysis means the scientific study that is subject to a number of rules and foundations that aim to improve working conditions.

-Hierarchical Tasks Analysis: "One of the methods of ergonomic analysis and evaluation, aims to describe the expected tasks, with a proposal to divide these tasks in a hierarchical manner until reaching the partial and sub-tasks." (Stanton, 2006.p.21)

### **- Human error:**

According to Erik Hollnagel: The term human error refers to human activity (typically, of the product user or system operator) or lack of activity, followed by erroneous behavior of the system.

-Failure to perform tasks: is the non-conformity of the activity (operations) in maintenance work with the standards and preventive procedures adopted by the institution.

-Defect/malfunction: malfunction, damage, harm to the electrical network or electrical transformers.

- Occupational hazard: Risque professionnel/"is the possibility of injury as a result of a certain property or capability of a device or machine with which the operator interacts". (ACMS, 2011) (translation by the researcher with some modification).

- Presque' accident: "An unexpected and sudden event without causing harm". (U.M.V.F, 2011)

- Occupational accident: Accident du travail/"An error with serious consequences". (About Mubarak. 2004. p. 207).

- **SHERPA method:** It is an abbreviation for (Systematic Human Error Reduction and Prediction) and is a systematic approach to reduce and predict human error. The SHERPA method is a systematic approach to reduce and predict human error. It was developed to reduce and predict human errors by Embrey (1986) as an ergonomic procedure and a method for predicting human errors. It also analyzes tasks and identifies potential solutions to errors in an organized manner.

-Ergonomic procedures and standards: These are the steps that the worker is required to adhere to in order to avoid harming the individual and his work team by adopting specific guidelines and instructions and personal protective equipment.

- Personal protective equipment: "Any device or means used with the aim of preserving the individual and protecting him from dangers that threaten his health".

### **6-Research Methodology/Study:**

The researcher used the SHERPA method in this study (Systematic Human Error Reduction and Prediction), which is a systematic approach to reduce and predict human error.

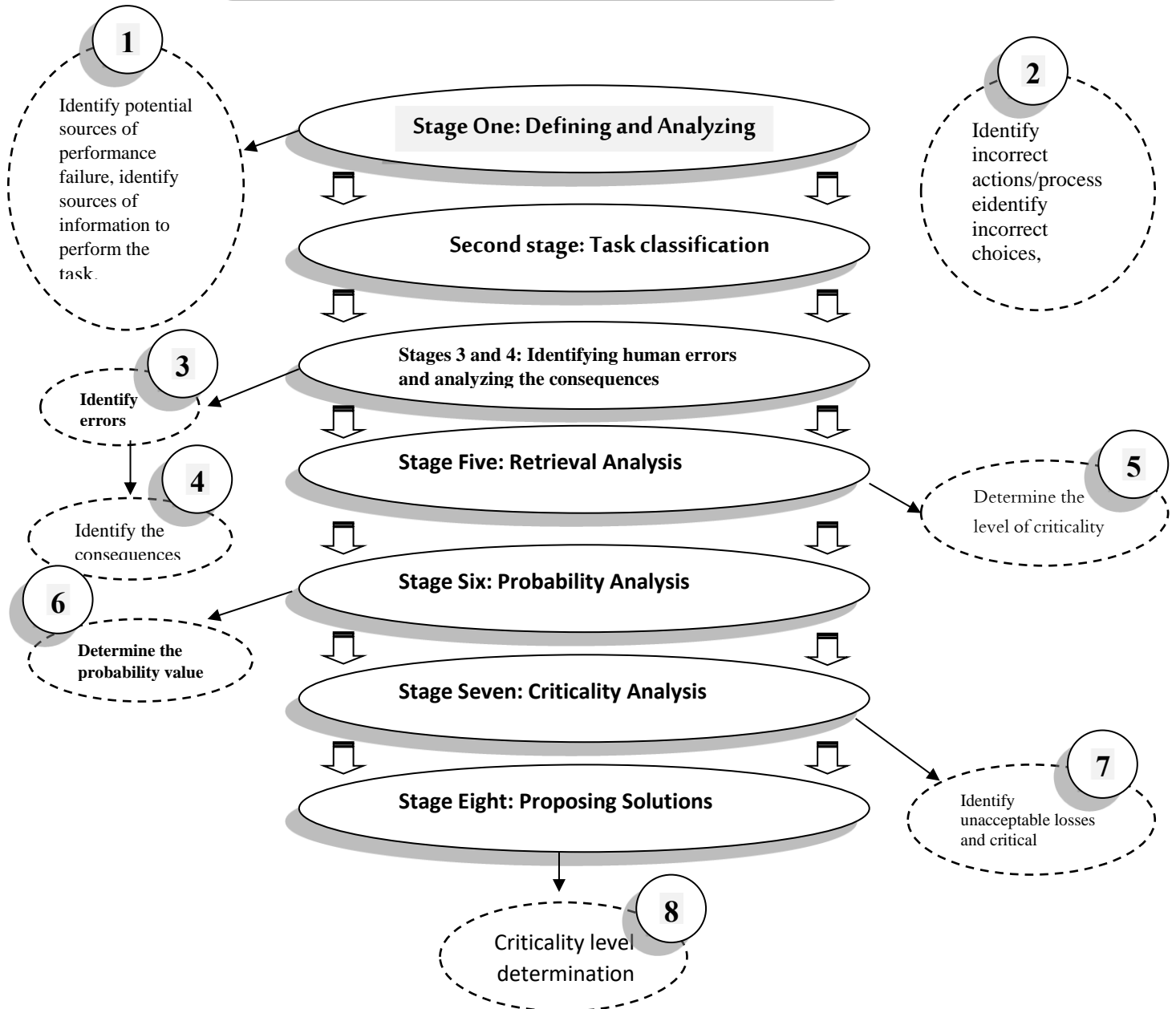
**6-1-Definition of the SHERPA method:** It is a systematic approach to reduce and predict human error. This systematic approach to reduce and predict human errors was developed by Embrey (1986) as a method for predicting human errors that also analyzes tasks and identifies potential solutions to errors in an organized manner. This technique is based on the classification of human error. In the original model, the psychological mechanism(s) causing the error were identified. This method is subject to continuous development, which includes removing this reference to the basic psychological mechanism. In general, most current human error prediction techniques have two main problems (Stanton, 2002), the first of which is related to the lack of representation of the external environment of things. In general, human error analysis techniques are based on the activity of devices and materials that the individual interacts with in a transient manner Hollnagel (1993).

### **6-2-SHERPA Method Procedures:**

The application of the SHERPA method includes a set of steps that we will try to explain in the following figure:

### **Steps to Apply the SHERPA Method:**

**Step-by-step flowchart of the SHERPA method**



- **Step One: Hierarchical Task Analysis (HTA):** Task analysis is a topic that touches on the daily activities performed by the worker in all human interactions, and the type of analysis depends on the analyst's goals. Relying on organized approaches to describe the characteristics of work and the models used in task analysis requires objective tools that share the methods of

approach despite the multiplicity of fields, as this method aims to integrate the goals and developments of changing events in the work environment by using this type of analysis (HTA) in controlled conditions (real-time processing) such as occupational risks and accidents. It also focuses on integrating all of the required simultaneous tasks that represent the evolutionary state of the system while continuing to perform tasks, and every new change that affects the management of movement is taken into account. (Francine. 1998)

-Limits of applying the Hierarchical Task Analysis (HTA) method: Work analysis based on the Hierarchical Task Analysis approach is a strict critical analysis of the details in which work is performed by raising a number of questions as shown in the example shown below:

A- How is The work done?

B- What are the approved methods for developing the work?

C- Why is the work done in this way?

In 1996, work in this way was encouraged because it takes into account the way in which tasks are performed, and it can also give a clear vision of future events based on the data obtained from the field about the reasons that could lead to failure of performance or pace. (Neville A. Stanton, 2006p.55-79) This method can be used in almost all fields such as designing systems and continuously re-analyzing tasks in different ways" Annett (2004) cited in (Neville A. Stanton, 2006). Hierarchical task analysis (HTA) is the term that encompasses the ideas developed by Annett and Duncan (1967) cited in (A. Shepherd, 1998). The hierarchy of goals aims at what a person is expected to do, and the plans formulated indicate the conditions under which the goals are to be performed. The work described by the Hierarchical Task Analysis (HTA) method has been successful in many practical applications. This is evident in Kirwan and Ainsworth (1992) (cited in (A. Shepherd, 1998) who presented a number of case studies describing the applications of task analysis. Despite the successes achieved, it is assumed that (HTA) is not suitable for dealing with cognitive tasks, the hierarchy is used to describe the system at a specific level and can be used to know the amount of control (control) over the system. This can be done in a hierarchical descending manner by moving from the top to the lower levels, it can also be compared to the production/maintenance systems used by cognitive approaches (A. SHEPHERD, 1998).

The (HTA) method is considered a very flexible method, its uses are represented in a variety of ways, as it has seven guiding procedural principles that we mention as follows:

- **The first principle:** The quest to analyze hierarchical tasks is not to seek to record tasks in their natural state, but rather it is a means to identify sources of actual or potential performance failure and suggest remedial methods, these methods may be in the form of redesigning equipment, changing the way the task is performed or achieving the optimal use of individuals or the content of training programs, and thus the result of the hierarchical task analysis tool is research that addresses the original question, such as designing work equipment or modifying operating procedures, or proposing a training approach, or to assess the risks resulting from performing tasks.

-**The second principle:** Determine the objectives, tasks and performance standards with the "assignees" of the task and stakeholders such as designers, managers, supervisors and trainers.

-The necessity of agreeing on the organizational objectives, values and desired outputs/(results). It is necessary to agree on objective performance standards. This step is done by submitting questionnaires and even negotiating with the parties concerned (subject to the study), because users may sometimes be unfamiliar with their objectives and the values of the institution's operation.

-**The third principle:** Identifying the sources of information to perform the task. It is preferable to benefit from many sources represented by documents, drawings and diagrams,

maintenance and operation procedures manuals, the opinion of designers, managers, teachers and operators, and also relying on records including accidents and main maintenance data.

Direct observation is considered a first wave to verify the opinions of workers about the task and the degree of their knowledge of it. (Annette, 2005, p.33, 2)

**-The fourth principle:** After obtaining data on the methods of performing tasks, we start with the goals at the top of the pyramid, i.e. the major goals and how to perform them by asking and observing what happens and what could happen, especially what could lead to error, i.e. (the consequences of failure) in the pursuit of a specific goal.

-The necessity of revealing the general structure of this task, such as long procedures, decision-making rules, and dual tasks.

-All processes subject to analysis at the same level must be (a) non-identical, (b) represent complete matching of the process and its consistency.

**-The fifth principle:** Re-examine the division of tasks and their validity with the stakeholders concerned with the study, to ensure that the analysis is consistent with the facts, constraints, and values associated with the task and its context. It is necessary to review the analysis or part of it in several stages in order to resolve the ambiguity as well as to set objective standards for performance associated with high-level goals and critical sub-processes, as this is the only means by which the validity of the analysis can be verified with evidence based on the problems that have been identified and sought to be addressed.

**- Principle 6: Identify critical processes based on the purpose of the analysis:** A single critical process is likely to fail by the standard to be followed. The cause of failure may become apparent when the process is inspected, focusing on failures resulting from task-specific inputs, plans and reactions. Inputs may be ambiguous, such as an illegible tool, or difficult to understand or comprehend (not knowing what to do). Inputs may consist of simple elements that include long procedures, such as complex decisions or dividing attention and effort between two or more requirements simultaneously. The feedback needed to correct performance may be affected by the individual's sensory inputs, especially if they are subject to delay.

**- Principle 7:** Propose and select hypothetical solutions to performance problems identified in the analysis after identifying potential sources of unsatisfactory performance, with clear solutions based on modern theories and best practices in this field. The purpose of the analysis depends on what was specified in the first principle (1) such as reconsidering the design of tasks and equipment or designing pre-determined training programs, but this does not prevent the analyst from directing attention to alternative solutions that may become important later.

**- Advantages of the HTA method:** As a general method, the HTA is adaptable to a wide range of applications, the ability to analyze tasks to any desired level and in some detail, depending on the goal, and when the HTA is used correctly, it provides a comprehensive analysis of the problem to be addressed. (Annette, 2005, p. 33, 3).

**- Step 2: Task Classification:** Each process at the lower level of the task hierarchy is taken in turn and classified into the following specific errors:

#### **A- Wrong procedures/operations:**

- Too short/too long.
- Inappropriate timing.
- In the wrong direction.
- Not modifiable.
- Too short process.
- Correct process in the wrong place.
- Wrong process in the right place.

- Omitted process.
- Incomplete process.
- Wrong process in the wrong place.

**B- Selection errors:**

- Omitted choice.
- Incomplete choice.
- Correct choice in the wrong place.
- Wrong choice in the right place.
- Selection at the wrong time.
- Wrong choice in the wrong place.

**C- Retrieval errors:**

- Information not obtained.
- Wrong information obtained.
- Incomplete information obtained.

**H- Communication errors:**

- Information not sent.
- Wrong information sent.
- Incomplete information sent.

**Kh- Identification errors**

- Deleted identification
- Wrong identification.

**-Step 3: Identifying human errors:**

This classification of the task is based on (Step 2) as it leads the analyst to examine the formulas of the detected errors while confirming the truth of their occurrence. The classification of the error is adopted based on a pre-determined table that includes the error

**-Step 4: Consequence analysis:**

Each identified error in the system is considered a basic step in the analysis. As the result determines the size of the risk.

**-Step 5: Recovery analysis:**

If there is an important step (a work situation in which a critical error appears), then the error can be addressed immediately, and if not, it can be postponed according to the level of criticality.

**-Step 6: Probability analysis (ordinal):**

An ordinal probability value is entered, either low, medium or high. If the error is not known.

If the error is pre-determined with a value

A low probability (L) is assigned. If the error occurred in previous situations.

A medium probability (M) is assigned.

If the error occurs repeatedly, then the probability is high (H)

This classification is based on data or records / or experts in the field.

**-Step 7: Criticality Analysis:**

- If the result is considered critical (i.e. it causes unacceptable losses), this is stated. Criticality is assigned in a binary way.



- If the error would lead to a serious accident (this must be clearly defined before the analysis), it is called critical (indicated as follows: !). Usually, one of the critical results is a result that causes significant damage to the plant or product and/or injury to employees.

**-Step 8: Proposing solutions:**

Solutions are presented according to the level of criticality of the risks.

**Conclusion:**

This paper is the result of a survey of several studies with an ergonomic approach and approach that in turn addressed the Sherpa method as a technique for reducing human error.

The research concluded that the Sherpa method is an effective method for diagnosing, reducing and even predicting human error, as this method is almost suitable for all work centers, and may be more effective in the field of maintenance, and this method requires other methodological techniques in its eight stages, such as the task hierarchy analysis technique.

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