Científica, vol. 28, núm. 1, pp. 01-36, enero-junio 2024, ISSN 2594-2921, Instituto Politécnico Nacional, MÉXICO
e280110 | DOI: 10.46842/ipn.cien.v28n1a10

DISSEMINATION

What seems to be the problem?

¿Cuál parece ser el problema?

Eduardo **Oliva López**

Instituto Politécnico Nacional, Ciudad de México, MÉXICO
ORCID: 0000-0002-0933-618X| eoliva@ipn.mx

Recibido 25-01-2024, aceptado 15-04-2024.

Abstract

This guide covers all the subjects of the detection-solution process of a problem. A considerable effort has been made to keep the language simple, practical, and accurate in order to make this document easy to read and to apply. The reader-analyst is invited to benefit from the successes and mistakes reported in 200+ industrial case-studies and postgraduate dissertations, directed and supervised by the author, in a wide variety of contexts, in the UK, Mexico, and USA, in 25+ years, including both public and private organizations.
The questioning process implicit in this guide, has been devised to follow a logical tree-like structure, starting with simple general aspects which gradually evolve into specific and deep subjects. Questions are approached in a general-to-specific sequence. However, any reader can adopt a different sequence, according to his/her own interests, thus enabling him/her to process the required information as it comes to his/her mind, without missing any relevant aspect.

Index terms: problem, detection, improvement, solution.

Resumen

Este artículo cubre todos los temas del proceso de detección-solución de un problema. Se ha hecho un esfuerzo considerable para mantener el lenguaje simple, práctico y preciso para que este documento sea fácil de leer y aplicar. Se invita al lector-analista a beneficiarse de los éxitos y errores informados en más de 200 estudios de casos industriales y disertaciones de posgrado, dirigidos y supervisados por el autor, en una amplia variedad de contextos, en el Reino Unido, México y EE. UU. en más de 25 años, incluyendo organizaciones tanto públicas como privadas.
El proceso de preguntas implícito en esta guía ha sido diseñado para seguir una estructura lógica en forma de árbol, comenzando con aspectos generales simples que evolucionan gradualmente hacia temas específicos y profundos. Las preguntas se abordan en una secuencia de lo general a lo específico. Sin embargo, cualquier lector puede adoptar una secuencia diferente, según sus propios intereses, permitiéndole así procesar la información requerida a medida que le viene a la mente, sin perder ningún aspecto relevante.

Palabras clave: problema, detección, mejora, solución.

Needed change is usually associated with current undesirable features of a given situation rather than with improvement opportunities; thus, ignoring that the universe is dynamic and… a proved recipe for failure is to remain without change.

This manuscript aims to help the analyst throughout the process of identification, characterization and change of situations deserving improvement.

Most situations needing change usually require existing knowledge and methods, although, in a few instances, the analyst may have to produce new knowledge and/or techniques in order to obtain the changes sought.

In the first case, the analyst will build up a team of specialists in order to set up a project aimed at yielding the expected results. In the second case, the analyst will have to design and perform some research work in order to generate the missing knowledge/method required to tackle the situation that needs change.

Chapter 1 depicts the concepts and ideas that constitute the foundations of chapter 2 (problems and situations). The analyses carried out in chapter 2, yield the information to be used in chapter 3 (general model), where a detailed examination of the main aspects of a professional /academic report is depicted. Chapter 4 examines the specific aspects characterizing original research work in order to distinguish it from other kinds of research.

THE USUAL APPROACH

Problems and attitudes. Sometimes, when we confront an undesirable situation, usually known as a problem, our first reaction could be:

a) To ignore its existence.
b) To pretend that we are not aware of it.
c) To detach oneself from its origins, its evolution, its possible consequences, its uncontrolled behavior, its reduction, its modification, or its elimination.
d) To identify the responsibilities of people involved in excluding themselves.
e) To deceitfully contribute with suggestions for its solution without becoming involved in the solving process.

An honest analyst will confirm that a responsible attitude shown through one or more of the 5 items above can only worsen the situation.

Therefore, an undesirable situation will continue to deteriorate, and its deleterious impact will tend to affect a more significant number of people, to a greater extent, until some effective interventions are carried out to reduce or eliminate most factors causing its existence [1].

AFFIRMATIVE ACTION

The perception and identification of undesirable situations (problems) is largely a choice of the people affected and should be encouraged when:

i. There is evidence of their existence via direct observation or through their impacts. A checklist could be used.
ii. There are indications that some aspects are out of control. Some references of acceptability are required.
iii. A confirmation method is needed to confirm its existence. A validated assessment method should be available.

Words in italics denote some intellectual tools suggested for the analyst to use.

A checklist consists of a purposefully devised set of questions posed to identify general aspects of the situation being examined. The amount and criticality of the adverse attributes spotted lead the analyst towards some immediate interventions and/or a deeper examination [2].

References of acceptability provide some indication of acceptability, previously established, for a set of crucial attributes depicting the situation under analysis. The suitability of each attribute should indicate to the analyst how to proceed further.

The suitability and effectiveness of a method should be validated for those situations where it is applied.

An evaluation method for a given situation consists of a set of orderly performed observations (qualitative and quantitative) in accordance with a pre-defined set of rules aimed at establishing the acceptability of the problem being examined.

It becomes pertinent to quote a concept emanated from popular wisdom concerning a large and complex problem.

Therefore, whenever an undesirable situation becomes evident for a large number of people, it is highly advisable to tackle it immediately. Regrettably, when all corresponding stakeholders do not perform suitable and timely interventions, the number of feasible actions becomes small, the cost of intervention grows higher, and the implementation period increases substantially. This is why the reader is advised to act as early as possible, according to points i, ii, and iii explained on the previous page.

HOW DO I KNOW THAT I AM FACING A PROBLEM?

Perhaps a better way to pose this question would be: Do I have a situation requiring some improvement? Usually, an honest answer will be YES. Although, we may not know the specific aspects calling for improvement.

Most people are willing to accept that they need to improve something; however, not many would readily admit that they are facing an undesirable situation, least of all that they have a problem. As we know, problems do have negative connotations for those facing them.

Above all, an analyst should know which situations he/she should be concerned about so that he/she can identify those that show undesirable features. Also, the analyst should define the desirability of their intervention for devising and implementing the necessary changes.

In the systems approach, everything is related to everything else. However, the analyst should be wise enough to avoid the wasting of scarce resources and allocate a high priority to situations impairing generalized improvement (bottlenecks). As an analyst, gathering professional experience, intuition, and good judgment also develops and facilitates faster and more effective interventions.

DO I REALLY KNOW THOSE SITUATIONS THAT I SHOULD BE CONCERNED ABOUT?

We usually tend to assume that we are acquainted with most situations that could affect us. However, when another analyst asks us to provide a detailed account of the distinctive and more relevant features characterizing such situations, we find ourselves unable to provide all the necessary information, thus exposing our lack of awareness of those situations [3].

Conversely, a knowledgeable analyst will usually be able to fully depict most situations concerning their responsibilities in an objective, concise, and well-structured manner, from all the perspectives of interest, including their constituent elements with their inter-relations, as well as their likely consequences.

It is essential to admit that some of our knowledge and thinking processes are intuitive. That is to say, they take place in our brains without our full awareness.

An experienced analyst is able to suitably combine their logical thinking with their intuitive capabilities in order to tackle most situations successfully, especially in those instances where some critical information is missing.

As for those situations that one should be concerned about, the required depth of analysis and its coverage will indicate the knowledge and intellectual tool needed so that one can properly state that: I do know most situations concerning my responsibilities well enough to achieve their improvement.

The analyst examines a situation of interest with some specific purpose in mind, and with an increasing level of awareness, through the application of updated knowledge and methods.

Purposeful observation yields new knowledge, which, in turn, poses new questions that, when properly tackled, lead to new hypotheses and generate new expectations.

Also, applied new knowledge satisfies the requirements of a set of existing needs and uncovers some previously ignored voids of knowledge. Thus, this gives birth to successive analysis-learning-questioning (SALQ) cycles. The questioning process is intrinsic to the inquisitive mind and holds the key to new knowledge and intellectual growth. The opposite is also true.

HOW TO DESCRIBE A SITUATION OF INTEREST?

An effective description of a situation requiring improvement should consider: its purpose and its prospective readers. Academically speaking, the written document should be well structured, complete, well supported, and accurate [4].

Report writing has been extensively documented; however, the logical relationships between the constituent elements of a report have not been sufficiently examined. This is the reason, this publication stresses the importance of the aforementioned relationship, which is why the depicted document becomes self-supported.

The writer tries to place him/herself as a prospective reader, posing the questions that a conscientious reader would try to answer properly.

A responsible writer would do his/her best to avoid incomplete and misleading information, as well as all kinds of biases and prejudices.

Most analysts begin their examination process with general aspects and proceed later with increasingly specific ones. General elements usually constitute a necessary background, whereas particular items tend to address critical issues that, necessarily, require complete and accurate information and analysis, in order to generate effective interventions.

An academic report, or a thesis work, is usually addressed to a specific set of readers. As for this guide, it is aimed at helping mostly, but not exclusively, academic researchers to help them provide the basis for a thorough characterization of a situation requiring improvement. This step is essential for the definition and execution of a harmonious set of improvement actions.

The questioning process is carried out in a cascading fashion, posing first some general questions that give rise, later on, to increasingly specific ones. It is expected that when the analyst has answered all the questions in a complete and accurate manner, the information thus gathered will represent a full characterization of the situation that needs to be improved.

The questions posed in this guide should be supplemented with those that the analyst could require for her/his own purposes.

The whole set of questions has been subdivided into subsets; each subset explores some specific aspect of the situation being examined.

However, the analyst is free to answer first those questions for which he/she already has a prompt answer. Also, some questions may be given a preliminary answer so that they become complete and accurate during a second or third review process. It should be borne in mind that not all questions become equally important in all kinds of situations.

Quickly browsing the entire questionnaire is advisable before attempting to answer any specific question. This will help the analyst to become acquainted with all the topics examined and to establish the most suitable examination sequence for him/her self.

1. PRIMORDIAL IDEAS

This chapter seeks to introduce the analyst into the fundamental concepts supporting this guide, and to get acquainted with the main features of its practical approach and application [5], [6], [7].

1.1 COVERAGE AND APPROACH

This article covers all the subjects of the detection-solution process of a problem. A considerable effort has been made to keep the language simple, practical, and accurate in order to make this document easy to read and to apply. The reader-analyst is invited to benefit from the successes and mistakes reported in 200+ industrial case-studies and postgraduate dissertations, directed and supervised by the author, in a wide variety of contexts, in the UK, Mexico, and USA, in 25+ years, including both public and private organizations.

Having been blessed with the financial and moral support of a host of well-meant individuals and firms throughout his professional development, the author is obliged to offer free advice to the owners of this guide on his/her first case-study or thesis work via e-mail to eoliva@ipn.mx. Special workshops will be organized for an extensive analysis and solution of case-studies deserving deep and multi- perspective examination.

1.2 Applicability and effectiveness

As any good manager, the analyst of a given situation should be concerned with the benefits/effort relationship for every project that he/she undertakes. A case-study or a thesis work is not different from this perspective.

The usefulness of this guide is strongly related to its ease of application in a wide variety of contexts, by a large diversity of analysts. At the same time, its effectiveness will be ascertained through the results achieved with a given amount of effort. An incipient analyst will find this guide helpful and effective, and the experienced analyst will find it comprehensive and straightforward for most practical situations.

The questioning process implicit in this guide, has been devised to follow a logical tree-like structure, starting with simple general aspects which gradually evolve into specific and deep subjects. Questions are approached in a general-to-specific sequence. However, any reader can adopt a different sequence, according to his/her own interests, thus enabling him/her to process the required information as it comes to his/her mind, without missing any relevant aspect.

Conceivably, a given situation stems from a set (network) of causality factors and yields a set (network) of likely impacts within a known context from the viewpoint of some pertinent perspectives. See details in the guide: “Piensa visualmente y logra tus metas” (Oliva-López, 2005).

Briefly put, a given situation generally stems from a network of inter-related causes, never from a single cause, as simplistic managerial tools tend to suggest. Likewise, such a situation usually generates a network of inter-related impacts (effects), never a single one. Moreover, as the aforementioned networks are further examined, at deeper levels of causality/effects, most analysts find out (not surprisingly) that some effects caused by previously unsolved situations tend to appear later into a sequenced causality branch as a source of a new problem situation. This, in turn, generates a set of deleterious cycles that can only be reversed through simultaneous interventions on critical elements of the causality/effects network.

Some genuine interest and a moderately inquisitive mind are the main resources that an individual needs when seeking the improvement of any situation.

1.3 Benefits and distinctive features

Experienced Project Managers would readily acknowledge that all projects face unforeseen situations and unexpected outcomes. This also holds true, of course, for improvement projects. Well managed projects, however, tend to have a more predictable behavior and show fewer undesirable events. This is why a thorough examination of the situation to be improved pays off in terms of the resources saved for its improvement.

It should be pointed out that the attitudes and motivations of the people involved do have a direct impact on the evolution and success of the improvement project throughout its various evolving stages: First, as certainty develops on the situation to be improved; later, as intermediate targets are achieved; finally, when all the objectives sought are achieved.

1.4 Primordial statements

Every time an analyst faces a new situation where his/her experience does not seem to be pertinent, an uncomfortable sensation appears and leads him/her to proceed cautiously while his/her mind explores some key questions that could trigger an effective enquiring process, such as the following:

Something seems to be wrong! Do we really have a situation here? How could I make sure that we do? Where do I begin my analysis? Has anybody tackled this before? How, when, where? What with? Which questions do I tackle first and in which sequence?

Some analysts try to answer the last question first, in order to follow a logical sequence. However, other analysts tackle first those questions whose answers they already know.

Not all minds work the same way. It is essential to consider that each analyst has a unique experience and prefers to try first those intellectual tools that he/she has previously applied with success.

Finding the best method for a given problem situation is an iterative and flexible process that is likely to change according to the analyst, the resources available, and the prevailing circumstances.

Once an undesirable situation has been properly identified, the leading analyst seeks to involve all the pertinent stakeholders, which very often poses a big challenge for teamwork. Since, as could be expected, each

stakeholder will tend to claim that his/her perspective is the most realistic and important, while attempting to bias the overall team effort for his/her benefit.

Lack of knowledge may also be an important obstacle, but it is not likely to be as negative as bad attitudes from the participants.

As we approach a novel situation calling for improvement, a perception- solution cycle begins to develop in the analysts' minds. The first step being the labeling of the situation as one that requires improvement. Of course, since no formal evaluation has taken place, such a label is allocated in a rather intuitive manner, largely based on the analyst's experience. Strictly speaking, this labeling step involves the activities shown below:

a) Relational perception
b) Pre-assessment and urgency
c) Willingness and readiness
d) Prioritization and start-up
e) Data gathering and characterization

Activities a and b are carried out in a rather intuitive manner by an experienced analyst on the basis of previous case studies and their merits for improvement. Once the case study at hand is qualified as deserving further examination, the next activity aims to involve all the pertinent stakeholders and prepare them for a formal improvement project. Activities d and e constitute the interphase linking the labeling step with the beginning of the formal improvement project.

1.5 QUESTIONING OF SITUATIONS

As perceived by popular wisdom, a thorough understanding of a given situation compels the analyst to bear in mind that any event has actually happened because a set of inter-related causes have jointly occurred. Likewise, once such an event has taken place, a set of inter-related consequences will duly manifest themselves.

An objective questioning process is triggered in the analyst's mind when the situation being examined becomes acknowledged as one deserving of improvement. Usually, the analyst begins a questioning exercise aimed at establishing some general features of the situation, as it stands, followed later by a set of questions exploring the reasons justifying the improvement needed.

Questioning processes are highly educational when approached as an intellectual game, without unduly urgency and pressure.

SPOTTING A PROBLEM

We usually perceive as a problem an adverse situation that has to be changed, improved or eliminated. Perceiving a situation does not imply its formal characterization but merely provides the analyst with awareness of its existence. Most of the undesirable obvious attributes of the situation become evident at this stage. As soon as an analyst realizes that something has to be done about it, a full characterization should then be pursued until all its attributes are known from all the pertinent perspectives.

Each individual perceives a given situation in a unique way. Nonetheless, most of us would readily admit that any situation can always be improved somehow. Few situations call for urgent attention, while others could be dealt with at a later stage. The severity of a situation and its undesirable outcomes should indicate to the managers the urgency of the intervention required.

Adverse situations (problems) are usually perceived through their observable deleterious effects, as they affect our interests in an undesirable way.

CONFIRMING THE EXISTENCE OF A PROBLEM

This can be done in two ways, namely: comparing unbiased opinions from a wide variety of perspectives and by achieving its complete characterization.

In both cases, the full involvement of all stakeholders is essential, regardless of the impact that the problem may have upon them and the system being examined.

How does this guide help its reader with his own PSP?

This guide helps the reader to tackle the three essential challenges in the PSP, namely:

a) To express the existing needs as objectives;
b) To specify and relate the methods (likely) to accomplish the objectives; and
c) To match the objectives with the outcomes obtained.

The ideas explained in this guide are meant to be simple and logical, based on the inquisitive process that an analyst uses when approaching a new and challenging situation, calling for a thorough and deep understanding as well as a thoughtful intervention. Its coverage is complete since it examines the full PSP.

A detailed recording and use of evidence is strongly suggested to support every step of the PSP in order to help the analyst achieve the required objectivity and certainty.

A distinctive feature of this guide is an objective examination of the causality and consequences of a given problem, as a compulsory requirement for a thorough and realistic PSP.

Benefits gained by using this guide

It is Flexible enough to be applicable in a wide spectrum of situations with a varied availability of resources. The extensive questionnaire that constitutes the essence of this guide lends itself to an individual or team (interdisciplinary) application and invariably yields a viable solution.

Purchasing this guide entitles the owner to call for the author´s advice and/or orientation on some specific questions on the PSP here depicted (forward your email message to eoliva@ipn.mx).

Main elements of this guide

It consists of a set of intellectual tools for diagnosing, implementing and evaluating an improvement change in a wide variety of practical situations. It includes but is not restricted to: term projects, improvement projects, applied research, thesis work, and change planning.

Potential users

This guide is useful for every individual facing the need to change something (solve a problem), making sure the change goes where it's really needed. It has proved its usefulness through the consistent application of its constituent elements in a wide variety of situations. When the PSP is properly carried out, the new situation will be endowed with the expected beneficial attributes and most deleterious effects will cease to exit.

Cultural aspects

It should be pointed out that a major challenge that is not specifically addressed in this guide is the organizational culture surrounding each particular case. This issue strongly influences the viability of all managerial interventions and deserves a deep analysis on its own. The reader is advised to examine these aspects through specific publications and experts dealing with organizational culture and regional culture prevailing in each particular case. See [8] for a deep analysis of cultural values.

Resources needed to apply this method

The main resources required are information and time. The method itself has a built-in sequence of applications. It is assumed that the analysts responsible for its application already belong to the organization being examined. Likewise, the investment and expenses required for changing some attributes of the existing situation into the new ones that suit our interests best, will depend on the extent of the changes sought rather than on the method used to achieve them.

Finally, the assessment of the achievements obtained should be done through the evaluation of the improvements made and their congruence with the priorities of the organization. It is equally important to

evaluate each improvement attained in terms of the resources spent to achieve it, in order to indicate the effectiveness of the allocation of scarce resources.

Emphasis on situation change instead of problem solving

Most individuals are willing to acknowledge that there is always something that they could improve on any given situation. However, very few of them would equally accept that they do have some problems. This is why situational change could be a preferred denomination for improvement.

Supplementary readings

The specific needs of supplementary readings for a given analyst vary widely in scope and depth. Therefore, the author includes a set of references (publications) meant to supplement this book in a large variety of pertinent topics.

Closing remarks

This book aims to integrate all the specific objectives stated at the beginning of each chapter. See point 1.1 The analyses of the ideas and questions posed from points 1.1 to 1.5, have been initiated on the reflections and fundamental knowledge required for performing the first steps of a problem-solving process in order to help the reader to get acquainted with the approach, the content, and the methods described in this book.

Link to next subject

Once the reader has become acquainted with the primordial aspects of the detection-solution process (situational change or situation improvement) as described in this chapter, it becomes necessary for his/her to obtain an introductory knowledge on the procedure suggested for a proper characterization of the situation meriting change, which is fully examined in the next chapter.

In all improvement projects, the achievement of the situation sought (as established in Chapter 2), is carried out through a series of gradual improvement cycles rather than through large improvement leaps. The latter may not only be unfeasible in most cases but may also become a threat to the system's stability. Once each improvement cycle is performed, it is highly advisable to check on the resources spent in order to keep an affordable goals/resources ratio.

Characterization of a problem

A full characterization of a situation can only be complete when all the causes of its existence and its consequences have been established. See Oliva-Lopez (2005) for a suitable methodology.

Ideally, we should know all the problem's features from all perspectives. However, it is practically impossible for a small team of analysts to ascertain what, if anything, is being missed in each particular case.

A common practice consists of beginning the analysis of a situation on a general level in order to identify most of its general features. Afterward, the analysts proceed with a deeper examination of the situation, in order to establish a set of the undesirable specific features linked to each of the undesirable general features. This procedure usually provides very useful clues about the existing voids of knowledge on the situation being examined and makes it evident that some specific features are not linked to any general feature, thus calling for further inquisitive examination of those links that seem to be missing, until all existing elements are properly linked.

A full coverage of the background and context of a situation to be improved should involve stakeholders from all disciplines and all levels within each discipline. This, of course, does not guarantee complete coverage but makes it feasible to approach it. Obviously, as the analyst departs from full coverage, he/she should be aware that the possibility of missing important features does grow simultaneously. So, additional measures should be taken to spot such omissions from the beginning.

The application of proven intellectual tools tends to facilitate full coverage, provided that such tools are wisely chosen and the analysts are proficiently trained on their use. In any case, it is wise to acknowledge that

most situations are dynamic and their features keep changing over time. Also, most interventions tend to face adverse feelings from some stakeholders, due to the initial animosity to improve the situation at hand, are often minimized (or ignored) at the implementation stage, but tend to appear later in the process as conflicting views emerge.

EARLY ACTIONS

Undesirable situations tend to deteriorate rapidly when they are ignored. So, it is highly convenient to tackle them as soon as they appear, in order to minimize their adverse impacts and to keep the required interventions simple and cheap.

Practical experience usually endows each individual with his/her own general problem-solving method (PSM); although most of them are neither formally depicted nor reported anywhere. Therefore, those methods that find their way into some pertinent publications, very often stem from a combination and/or evolution of seminal unpublished versions that have been particularly effective.

Each activity, as simple as it may seem, is part of a method, although this is not always evident. Intuitive methods are usually not evident, but they often provide effective outcomes.

In addition to general PSM's, each field of knowledge has its own specific PSM's, which have been developed by the experts of each field for tackling specific situations pertaining to the field in question. All analysts are expected to know all PSM's within their field of expertise.

Some examples of general PSM's are brainstorming, scientific, Cartesian, trial-error, mental maps, etc.

Most problems require a combination of a general PSM and some specific PSM's for their solution.

To begin the problem-solving process, the analyst should know all the features of the problem to be solved before attempting any intervention on it.

The observer (analyst) becomes aware of a problem by perceiving its existence through one or more of its manifestations. So, perceiving the problem constitutes the first stage of the Problem-Solving Process (PSP) and consequently requires one (or more) methodology to perform it properly (completely, accurately, and without bias).

Unfortunately, such a method does not exist as yet. Therefore, analysts are advised to find, for each case, a combination of methods and approaches that best suits their needs without unduly relaxing their requirements of coverage, accuracy, and absence of bias.

More often than not, the analyst´s thoughts tend to swing in the PSP from one stage to another in an exploratory way, as if a stroke of luck could find a good solution. This, of course, is very unlikely. Still, such exploration provides the analyst with some glimpses of the challenges to be encountered at later stages of the PSP, thus leading the analysts' efforts towards the development and implementation of a feasible improvement plan.

FINISHING THE PSP

The essential analysis for finishing an improvement project is to compare the objectives originally established against the results achieved. To this end, it is advisable to devise some suitable congruence and effectiveness criteria (subject specific) early in the PSP. It also helps to establish concrete and achievable objectives.

A table format has proved very useful for comparing the attributes sought against the outcomes achieved; also, it becomes very useful for weighing the outcomes if it is required.

1.6 CHARACTERIZING A SITUATION FOR IMPROVEMENT

The better the analysts know the situation requiring improvement, the more able they will be to deal with all the undesirable features (attributes) that need to be changed.

The best way to identify and inter-relate all the elements featuring a given situation is by devising a conceptual diagram containing such information. Figure 1 shows an example of this kind of diagram.

The situation being examined is usually located within a broad social and economic environment. The main constituent elements of the situation are shown as geometrical symbols in the diagram of Figure 1, and are interconnected by meaningful arrows that indicate the existing relationship between them.

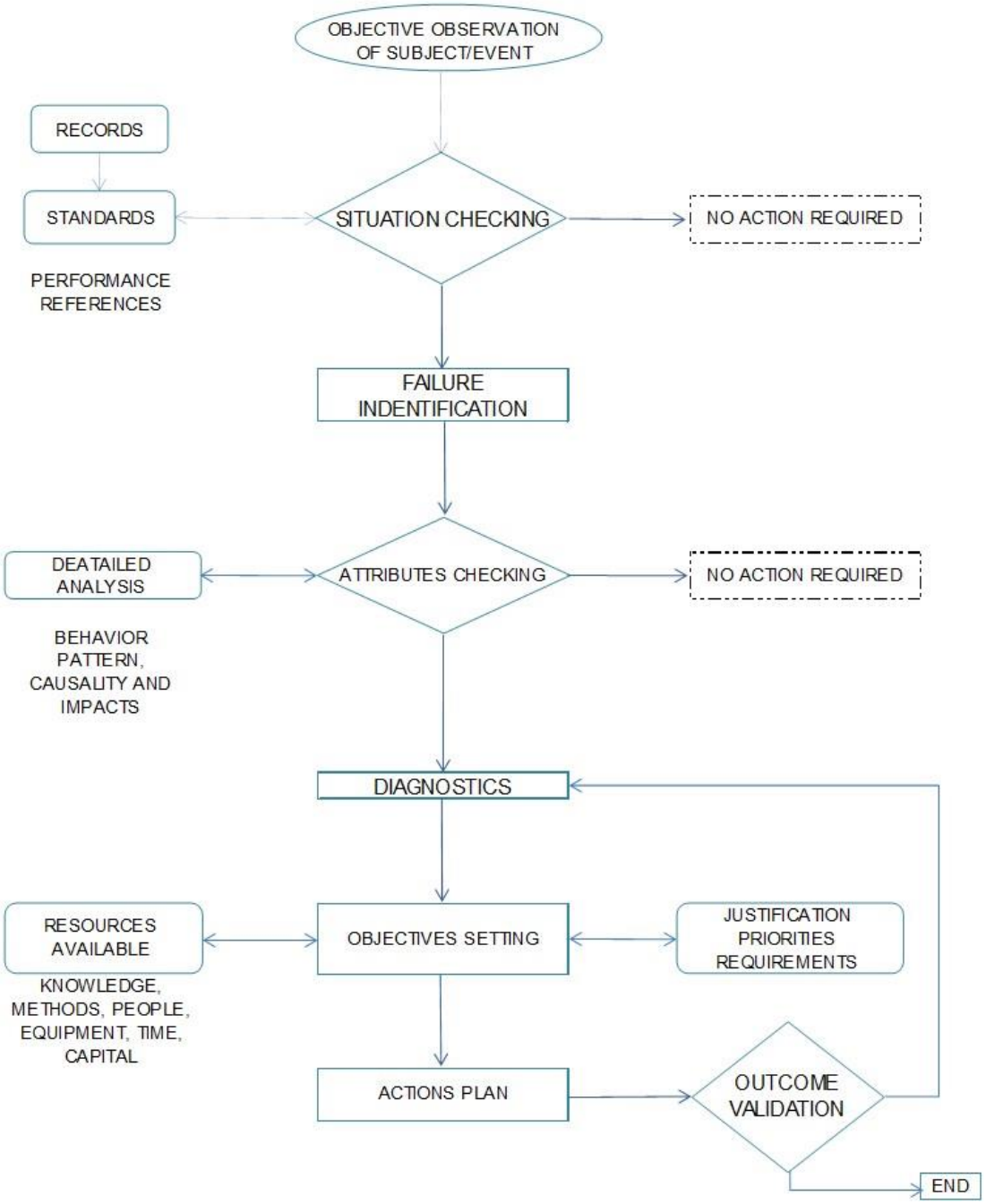

Fig. 1. Elements of a Situational Change.

Figure 1 addresses each element with a general designation. For example, the large ellipse symbol called objective observation stands for the purposeful observation of the subject being examined. In a case where an expected productivity level is not attained, the observable problem would be a low productivity level, and this label would be written inside the large ellipse symbol.

Consequently, the ellipse entitled standards would become productivity standards, assuming that there is an applicable productivity standard to be achieved.

Once the analyst-observer has spotted the situation calling for improvement, this situation is examined in terms of its existing attributes in order to check which of them, if any, are departing from their standardized value.

Previously recorded values depicting a satisfactory behavior of the process/system under analysis become very useful in the absence of a standard. Occasionally, such attributes need to be examined in terms of the vision and mission of the organization for congruity.

The outcome of this analysis is interpreted to understand its causality and likely consequences. Some consequences may, sometimes, match undesirable attributes that should be modified (or eliminated) as their causality (primordial roots) is understood. Then, some suitable interventions should be devised and implemented in order to yield the expected outcomes that will improve the situation. Causality could initially be examined with a fishbone diagram (Ishikawa, 1999), although a deep understanding would require a cause-consequence network (Oliva et al, 1999).

Figure 1 contains the basic elements to be included in a diagram depicting a situation that merits improvement. Each analyst is invited to modify this diagram to suit his/her interest and resources in each application. Contact the author if required.

The actual applicability of each element of the diagram should be examined by the analyst in terms of its essence, its purpose, its justification, its implicit and explicit requirements, its outputs, and its relationships with other elements from the perspective of its current application. The output of this analysis should be conveniently recorded to become an important chapter of the project's report.

An improvement project stems from the fact that a process under examination is not performing the way it should. Of course, deviations from an acceptable performance could vary from a slight to a radical one. Obviously, the larger the deviations from the standard, the more complex and detailed the improvement project will be aimed at regaining the standard performance.

It is important to point out that not all interventions are equally beneficial. So, it is advisable to make an estimate, for each foreseeable intervention, about the goodness of its benefit/effort ratio in order to allocate the available resources in a highly effective way. Likewise, special attention should be given to the methods to be applied for each intervention since the goodness of each method is also dependent upon the expertise of the executor.

Change Cycles.vsd

Fig. 2. General method for improving a situation.

1.7 Comments on benefits/effort ratio

Is it often advisable to perform a detailed examination of the situation to be improved in order to ensure the quality of the improvement sought and the availability of the resources needed? The analyst will resort to his/her experience and judgment to establish an optimum level for the benefits/effort ratio and, if required, seek additional resources to achieve the objectives sought.

Most analysts are often asked to simplify their methods and save time and resources without sacrificing the effectiveness and quality of the results sought. However, experience repeatedly shows that quick, simple, and cheap interventions usually lead to gross, misplaced, and deceitful results. Thus, do we end up frustrated and consuming too much resources?

This is why realistic expectations should be established at the outset, together with a well-defined program of activities/outcomes and budget, in order to ensure the success of the project at hand.

It is pertinent to acknowledge that negligence and a simplistic approach naturally lead to deceitful and useless results which, in turn, are likely to mislead and bias the analysis and improvement of a situation, thus invalidating the outcome of the whole intervention.

1.8 Practical analysis of perception

The perception of a situation by its stakeholders depends on sensitivity factors, pertinence, meaning, and significance of the related information gathered, as depicted in table 1.

It is essential that the analyst becomes aware of all these factors to prevent and/or reduce the possibility of ignoring, misinterpreting or biasing his/her perceptions on a phenomenon, process or event being examined.

Without a conscientious effort to prevent these mistakes, the analyst is bound to incur on one or more of them, thus misleading his efforts and invalidating the whole improvement exercise.

A natural premise regarding perception is that: we only perceive those things that our senses allow us to. To increase their perception capabilities, human beings have devised and applied a large variety of technical aids to help them perceive a wider and deeper reality, as required in each instance.

Once a given perception is properly obtained, a duly recording should be made of it to build up the required evidence of its existence. This data could be later supplemented and/or compared with the perceptions of other observers.

It is worth noticing that an analyst usually perceives a given event or behavior as pertinent data only when it is meaningful from his/her perspective. This implies that some data/signal discrimination process takes place whenever an observer/analyst examines it. Therefore, most observation exercises are likely to ignore/dismiss data/signals that are missed or pre-judged as useless for the study/analysis being carried out. As illustrated in stage 1.3 of table 1. This neglecting action, of course, is likely to mislead the research process and bias its outcome and its interpretation.

Unconscious data processing in the analyst's mind is unavoidable; nonetheless, it is essential to be aware of its existence in order to distinguish between true and imagined evidence. True evidence must stand as such regardless of the observer/analyst who found it.

Missed/biased information could be avoided as the analyst widens and deepens her/his knowledge and perspectives on the situation being examined.

Original research work tends to compel the analyst towards the development of new codes and new referential knowledge so that newly decoded data can be appropriately interpreted and understood. However, replicated research may only need the development of new perspectives stemming from related disciplines.

The examination of a set of data can only yield some useful outcomes when the findings can be properly placed in a pertinent body of knowledge; breakthroughs are excluded.

Tabla I. Stages of data processing by analysts.

STAGES OF DATA PROCESSING					
DATA PERCEPTION		DATA DECODING		DATA INTERPRETING	INFORMATION MEANING
DIRECT	RECORDED	DECODING TYPE	CULTURAL	DIRECT / AIDED	TRUTHFUL
			CONTEXTUAL		
AIDED			DESIGNED		
			HIDDEN		DOUBTFUL
	NOT RECORDED	NOT DECODE	UNKNOWN	NOT POSSIBLE	NON EXISTENT
MISSED			NONE		

2. SITUATIONS AND PROBLEMS

This chapter aims to pose a set of questions that are meant to lead the analyst throughout an enquiring process that is set out to establish the main features of a situation meriting improvement.

2.1. General concepts

2.1.1. Premises

Which concepts should be previously established for an effective questioning exercise?

2.1.2. Perfect perception

How does the analyst take notice of the situation being examined?
Why is it essential to get a thorough perception of the situation being examined?
Is it possible to obtain a thorough perception of a situation?
Which should be the essential questions to be posed by an objective analyst?

2.1.3. Perceived situation and bias

Which biases is the analyst liable to incur upon and to what extent?

2.1.4. Problem-solving versus situational change

Which connotations does the analyst have on problem, change and improvement?
Which implications are there in using any of them when addressing a specific situation?

2.2. Making sure there is a problem

Why should we confirm the existence of a detected problem?
How do we proceed to confirm it before allocating valuable resources to solve it?
What kind of evidences would confirm its existence?

2.3. Awareness for improvement

What should be the essence of awareness for improvement?
When and where does awareness for improvement become important?
How could this awareness be built or developed?

2.4. Motivation and resources

Why is it important to integrate all stakeholders properly motivated?
What kind of motivation are the stakeholders likely to respond to?
What kind of benefits would be appealing to providers of the required resources?
Will it be necessary to obtain approval for any external instances?

2.5. Data sources

Which data should be examined? What are they related to? What does it stem from?
How has this data been collected? What do they represent?
Who is the data supplier? Which quality criteria should the data fulfill?
How should the data be structured and coded?
Does the coding allow an unmistakable interpretation?

2.6. Sources of knowledge

What is a source of knowledge?
Why are they required?

Where are they available?
What role does a handbook fulfill in each profession?
What is the role of a magazine?
How many kinds of books are there? Where is the new knowledge first published?
Who validates the publication of new knowledge?
How old are the most recent publications related to the situation being examined?

3. GENERAL MODEL

The objective of this chapter is to pose a set of questions that may lead the analyst to establish the complete specific features of the situation being examined [9].

3.1. MODEL ELEMENTS

3.1.1. Justification and logical description

The elements integrating an improvement project adopt different varieties according to the situation being tackled. The most common has evolved, but some distinctive features have become strongly undesirable.
Other projects deal with new processes, new equipment or new enterprises where a thorough questioning is highly advisable in order to endow the latest development with the required competitive features as well as to prevent waste of resources and marketing failures.

3.1.2. Relationship between elements

Figure 1 shows the main relationships between the elements of the model. The reader is invited to perform a detailed examination of this relationship in order to achieve a full understanding of its structure and functioning.

As a first step, a situation calling for improvement should be identified and recorded, establishing its main features and highlighting those that deserve special attention. The analyst/observer may want to supplement her/his perception and perspective by involving other stakeholders in this exercise. This will prove very useful for confirming the existence of adverse features and justifying a suitable intervention.

The reader will find that, owing to their great importance in Figure 1, the central blocks of the diagram, as well as their relationships, are examined in detail in Table 1, which has been designed for that purpose.

3.2 BACKGROUND OF THE SITUATION FACED

Which is the object being examined, and where is it located?
Which are its constituent elements?
Which is the perspective of this analysis?
Which have been its most noticeable and recent changes?
Which rules and regulations become applicable in this case?
Which other object objects and systems bear a meaningful relationship, and how it shows?

3.3 CHARACTERIZING THE SITUATION FACED

An Analyst can only be sure that he/she knows an existing situation when he/she knows all its constituting elements and the relationships between them, as well as the various ways in which they can be perceived from the perspectives of interest. The best way to characterize a situation calling for improvement is through its current attributes by specifying its depicting characteristics, especially those which are distinctive and/or unique.

An objective way to characterize a situation of interest is by specifying all its attributes, not only the ones that already exist but also those that seem to be missing.

Existing attributes could be conveniently classified into three types, namely, excellent, satisfactory, and undesirable. The undesirable ones could still be sub-classified into two types: to be improved soon or for later improvement. Current excellent attributes do not usually require any improvement action, whereas satisfactory

ones may justify some improvement efforts. Consequently, most of the analyst's attention is devoted to undesirable attributes, especially those that have to be improved soon.

Table 2 shows a format that has proved very useful for identifying and classifying the attributes of a situation. The analyst needs to visualize the way (method) in which an undesirable attribute can be changed in order to become a satisfactory one. An improved attribute may preserve its original denomination or adopt a new one, depending on the analyst criteria. Straight arrows from column 2 to column 4 link original attributes with their corresponding new versions. Thicker arrows show the change of an attribute, whereas slim arrows stand for attributes without any change.

Each improvement sought through a new attribute entails the realization of a specific objective, which implies the application of one or more methods. Column 6 of table 2 shows the goals to be achieved through the change of each new attribute. As a supplement to this table, the analyst may want to include an additional column 7 to specify the method(s) to be applied to achieve the objectives shown in column 6.

The main virtue of table 2 is that it integrates, in a systemic way, the main features of a situation calling for improvement, allowing the analyst to focus on specific attributes of the situation, in terms of the specific changes required.

- Specify the general attributes of the situation under analysis from your perspective of interest.
- Which intellectual tools could the analyst use to identify these attributes?
- Which methods could the analyst resort to for a thorough specification of the situation?
- Are all the stakeholders aware of the undesirable attributes of this situation?

TABLA 2. SPECIFICATIONS OF ATTRIBUTES.

CURRENT SITUATION		ATTRIBUTES CHANGING	IMPROVED SITUATION		EXPECTED OUTCOME	SPECIFIC OBJECTIVES PURSUED
Excellent	Exc 1	→	Exc 1	Without change	As before	As before
	Exc 2	→	Exc 2		As before	As before
	Exc 3	→	Exc 3		As before	As before
Satisfactory	Satisf 1	→	Satisf 1		As before	As before
	Satisf 2	→	Satisf 2		As before	As before
	Satisf 3	→	Exc 4	With improvement	As planned	New specific objective 1
	Missed 1	→	New 1		As planned	New specific objective 1
Missing	Missed 2	→	New 2		As planned	New specific objective 1
	Change soon 1	→	Improv 1		As planned	New specific objective 1
Undesirable	Change soon 2	→	Improv 2		As planned	New specific objective 1
	Change soon 3	→	Improv 3		As planned	New specific objective 1
	Change later 1	→	Change later 1	Without change	As before	As before
	Change later 2	→	Change later 2		As before	As before

3.4 DIAGNOSTICS

Which current attributes are undesirable in the current situation?
What has been the origin of undesirable attributes? How did they appear?
Which events prompted their existence?
Which adverse consequences could be foreseen? Have they been evaluated?
How could these consequences be eliminated or reduced?
How could desirable attributes be developed and deployed?

3.5 IMPROVEMENTS SOUGHT

A current situation can be improved by changing some of its undesirable attributes and the relationships between them, as illustrated in table 2.

Make a complete listing of all the attributes of the situation being examined. Involve all the stakeholders.
Do the analysts have all the pertinent knowledge for the identification and classification of attributes?
Do the analysts have a suitable working knowledge of the methods for eliminating/transforming all the undesirable attributes of the situation?
Can the analyst develop an estimate of the resources required for changing undesirable attributes?
Is it advisable to perform these changes in several stages?
Are the resources needed already available?
Are all the stakeholders aware of the consequences of the changes being generated?

4. ESTABLISHING OBJECTIVES

4.1. SPECIFIC OBJECTIVES

Changing an undesirable attribute entails the achievement of a specific objective, as shown in Table 3. However, some objectives may depend on changing more than one attribute. Likewise, each attribute change requires the application of one (or more) specific methods. A thorough examination of this table will show the reader that no attribute, objective or method should stand alone in the analysis [10].

The analyst can verify that the information in table 3 is complete when the achievement of all specific objectives entails the realization of the new situation pursued.

Pertinent questions

Are the achievements sought fully and clearly specified, as well as their due dates, allocated resources, and responsible leaders?
Are the stakeholders aware of their implicit commitment and expected contribution?
Are the established objectives fully achievable within the time and resources allocated?
Is each specific objective uniquely related to well-defined attributes of the new situation pursued?
Is the new situation pursued fully and truly depicted by its endowed attributes and their related objectives?

4.2. GENERAL OBJECTIVE

Are all specific objectives harmoniously integrated into a general objective?
Is this objective fully achievable with the time and resources allocated?
Is the general objective in agreement with the strategic prospects of the organization?
Is this objective congruent with those established by other managerial entitles of the organization?

5. IMPROVEMENT METHODS

5.1. GENERAL METHOD

A method is an intellectual tool for achieving an objective. It usually comprises a set of steps that should be performed in an established sequence. Performing each step requires the realization of one or more activities which, in turn, yield one or more outcomes. Non-productive activities are not usually justifiable [11].

A general method tends to be widely applicable, whereas a specific method is usually addressed to meet the requirements of a well-defined situation. Most situations call for a general method to be applied at the outset, and then, as the knowledge of the situation becomes more comprehensive and some preliminary outcomes become available, one (or more) specific method is applied to obtain the supplementary results pursued.

The main features of a general method stem from the requirements that it should fulfill under a set of well-known circumstances. Overall, an intellectual method would require an established set of inputs (data, resources) that would be subjected to a given processing in order to yield some expected outcome. Flexible methods allow the analyst to make small variations and adjust them to varying circumstances [12].

Table 3 depicts the content of a general method to be applied to investigate the requirements for improving a situation of interest.

The first column of the table comprises the main steps to be carried out, whereas the second column suggests some specific methods to be used with each of these steps. The analyst should modify this table to meet his/her information requirements. The questions posed below become pertinent when the analyst seeks a suitable pertinent method for a given situation.

TABLA 3. MAIN STEPS OF A GENERAL METHOD.

MAIN STEPS	SPECIFIC METHODS	ACTIVITIES REQUIRED	REQUIREMENTS
Appreciation by stakeholders	Posters, fliers, leaftlets, booklets, surveys, group discussion, conferences.	Evaluate organizational climate, promote suitable conditions.	Effective communication channesls, medium to high mutual trust, suitable leadership.
Vision and goal setting	Brainstorming, conceptual diagrams, cause-consequence analysis, SWOT, analysis.	Data collection surveying, expert consulting, model building, performance evaluation, multi perspective analysis.	Complete and reliable data, experienced coordinator, objective management.
Identification of current and desirable attributes	Checklist, assessment guidelines, standards and procedures.	Specification of undesirable attributes, specification of desirable attributes, benefits / risks evaluation	Complete and reliable data, experienced coordinator, involvement of all stakeholders, resources availability.
Identification of specific objectives	Enlarged cause-consequence analysis (strategy), benefits/risk analysis, systems analysis.	Builda cause-consequence nelarged diagram, develop a befefits / risks improvement plan, Visualize specific objectives.	Objective approach, Merging of strategic issues into situational change.

What is a general method?
Which are the distinctive attributes of a general method?
What is the purpose of a general method?
Are general methods replaceable?
Are general methods empirical?
Are general methods scientific?
Is your general method widely known and acknowledged?
Is your general method integrated with some specific methods or with some elements of them?
Has your general method been properly validated?
Does the analyst have a general method for achieving the general objective?
Are there several general methods?
Is the analyst knowledgeable of all pertinent general methods?
Is the analyst required to know other general methods?
Are the additional methods required accessible and applicable?
Is the analyst able to make a sound selection of the best methods for each situation?

Table 3 illustrates the way to improve a given situation (situational change) by working on its current attributes to generate its improved counterparts. It should be noted that each attribute change entails the achievement of a specific objective. Likewise, each specific objective calls for the application of one (or more) particular methods, each of which will require the allocation of a given set of resources, as shown in table 4.

In a similar way, as in table 3, the third column of table 4 shows the main steps comprised in each specific method, as well as those activities required for the application of each step. Every activity must yield some expected outcome to justify its realization.

TABLA 4. ILLUSTRATION OF METHODS APPLIED TO ACHIEVE OBJECTIVES.

OBJECTIVES SPECIFIC FOR EACH CHANGE	METHODS SPECIFIC FOR EACH OBJECTIVE	MAIN STEPS OF EACH METHOD	ACTIVITIES REQUIRED FOR EACH STEP	RESOURCES NEEDED FOR EACH ACTIVITY	OUTCOME PRODUCED BY EACH ACTIVITY
oa	ma	ma1	a1ma1, a2ma1	Specify amount, quality and timing	Products of a1ma1, products of a2ma1
		ma2	a1ma2	Specify amount, quality and timing	Products of a1ma2
		ma3	a1ma3, a2ma3, a3ma3	Specify amount, quality and timing	Products of a1ma3, products of a2ma3, products of a3ma3
o1	m1	m11	a1m11	Specify amount, quality and timing	Products of a1m11
		m12	a1m12, a2m12	Specify amount, quality and timing	Products of a1m12, products of a2m12
o2	m2	m21	a1m21	Specify amount, quality and timing	Products of a1m21
		m22	a2m22	Specify amount, quality and timing	Products of a2m22
		m23	a1m23, a2m23	Specify amount, quality and timing	Products of a1m23, products of a2m23

RELATIONSHIP OBJECTIVE-METHOD

How is your general objective linked to your general method?
Specify the links depicting this relationship.
Has the validity of these links been tested under pertinent circumstances?
Would these links be different if the general method is changed?
Is it possible to illustrate the links between your general objective and your general method?

RELATIONSHIP BETWEEN GENERAL METHOD AND ACTIVITIES

Are there some general activities directly linked to the application of the general method? If so, make a listing.
May these activities vary depending on the performer?
What variations could be expected in the method/activities?
Could such variations affect the effectiveness of the general method? If so, how?
Is it possible to reduce or eliminate such variations?
How are the steps of the general method related to their corresponding activities?
How is the outcome of every step linked to its successors and to the achievement of the general objective?
How could these links be illustrated in a block diagram?

5.2 SPECIFIC METHODS

Does the achievement of a specific objective call for one (or more) specific method? Does your general method comprise a set of specific methods? Figure 3 shows the relationships between some common specific methods. As the reader can appreciate, these specific methods have been grouped in three sets, namely: perception-observation, interpretation-evaluation, and diagnostic-change. Each of these sets is aimed to tackle a specific stage of the problem-solving process [2], [13], [14].

These sets of specific methods are iteratively applied until all the specific objectives have been achieved. Figure 3 shows only some obvious relationships between these specific methods. It will always be up to the analyst to figure out some additional links that will enrich the diagram and make it more meaningful in each instance without unnecessary complications.

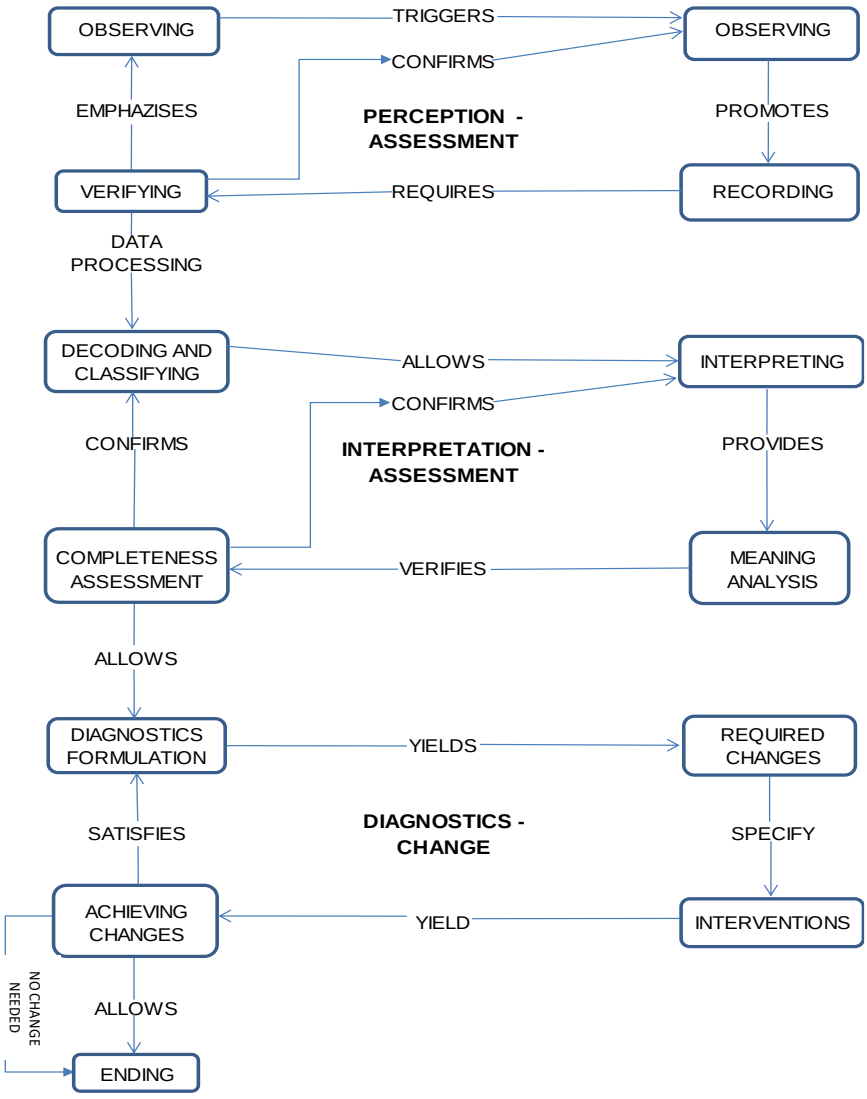

Fig. 3. Relationships between specific methods.

NATURES OF SPECIFIC METHODS

Are your specific methods of an empirical nature?
Do your specific methods follow a scientific process?
Are your specific methods widely known and acknowledged?
Have all your specific methods proved to be effective for the purpose (under the circumstances) that you are applying them?

Have all your specific methods been properly validated?

RELATIONSHIP BETWEEN SPECIFIC OBJECTIVES AND METHODS

How is each specific objective related to each specific method?
Which are the links that show such relationships?
For how long and under which circumstances is each relationship valid?
Do such links vary according to the method applied?
Is there more than one specific method for any specific objective?
Is there one single specific method for two or more specific objectives?

RELATIONSHIP BETWEEN SPECIFIC METHODS AND ACTIVITIES

Does every specific method comprise one or more activities?
Is every activity uniquely defined and depicted?
Are there all activities linked to a specific method?
Do the activities of a specific method vary according to their performer?
How is such variability justified and explained?
To what extent does the variability of application affect the effectiveness of a given specific method?
Would it be possible to reduce or eliminate such variations of a method?

5.3 HYPOTHESES

How many types of hypotheses are you testing?
Are all your hypotheses explicitly formulated?
Is there a formal process for formulating your hypotheses?
How should your hypotheses be tested?

5.4 FUNDAMENTALS OF A METHOD

5.4.1 TYPES OF KNOWLEDGE AND DOMAIN LEVEL

What types of knowledge does the analyst need? Which domain level is required for each of them?
Can you specify which knowledge is essential and which is supplementary?
How do you establish the level of knowledge required by the analyst in terms of the general and specific methods to be used?
How should the analyst proceed when the existing knowledge level is not enough?
How could the required knowledge be obtained or generated?

5.4.2 THEORIES, MODELS AND BEHAVIOR LAWS

What is a theory?
What is a model?
What is a behavior law?
How is a theory developed?
How is a model built?
How is a behavior law discovered?
What is the use of a theory, a model and a behavior law?
Which theories, models and behavior laws could be useful in the situation that you are examining?
Which relationships do they bear with the situation at hand?

5.5 APPLICATION OF METHODS (ACTIVITIES)

5.5.1 RELATIONSHIPS OF SPECIFIC METHODS-ACTIVITIES

Which activities should be performed to apply each specific method chosen?
Which resources are required (amount, quality and timing) to perform each activity?
Are all those resources available?
Is there a responsible individual for each activity? Is he/she willing and able to perform it?

5.5.2 RELATIONSHIP OF PRODUCTS-ACTIVITIES

Fully justified activities should always be related to a methodological step and yield at least one useful outcome, which, in turn, should contribute to the achievement of a specific objective, as can be observed in figure 4.

Is the outcome produced by each activity fully specified?
Is there an activity that does not yield an outcome?
Is there an outcome produced without an identified activity?
Is there an outcome produced jointly by more than one activity?
Is there an outcome produced in excess?

5.6 RESULTS OBTAINED

5.6.1 OUTCOME NATURE

What type of outcomes do you expect to obtain?
How will you distinguish the essential results from the important and the supplementary ones?
Will all the results be equally meaningful for all the analysts involved?
How will you make sure that all the required results have been obtained?

5.6.2 OBJECTIVE ORGANIZATION OF RESULTS

How should the results obtained be classified and organized for an unbiased and meaningful interpretation?
What evidence do you expect to obtain from the expected results?
How should the results be reported to ease the discovery of the evidence sought?
Which set of criteria will you use to validate the evidence found?

5.7 ANALYSIS OF RESULTS AND OBJECTIVES

5.7.1 CRITERIA FOR INTERPRETING RESULTS

Is the analyst acquainted with the kind of results to be obtained?
To what extent is the expected outcome foreseeable?
Are there any established criteria for interpreting the foreseeable outcome?
How and under which circumstances were such criteria established?
Which were the theoretical and practical criteria identified?
How such criteria were originally validated? Have they been recently validated?
Has the validating team been properly qualified (certified)?

5.7.2 SPECIFIC RESULTS AND SPECIFIC OBJECTIVES

Does the analyst know the results required to fulfill each specific objective?
How will the sufficiency of results be ascertained?
Has there been any unexpected outcome? If yes, please specify.
What would be the meaning of an unexpected outcome?
How does the analyst deal with an unexpected outcome?

5.7.3 Overal results and general objective

Does the analyst know the set of results that should fulfill the general objective?
Has this set of results been obtained through the integration of all the specific outcomes?
Are the integrated specific outcomes congruent with each other?
What is the meaning of existing incongruities? If there are any.
Which steps of the project need a review to eliminate incongruities?

5.7.4 Supplementary results and objectives

How relevant are the supplementary results?
Do the supplementary results require an adjustment of any objectives?
Do the supplementary results call for a review of the methodology applied?
Will it be necessary to review any of the activities performed to find the source of unexpected outcomes?

5.8 Retrospective analysis of the methodology

The analysis of a situation deserving some improvement takes place, usually, by applying the methodology illustrated in figure 4. However, once the outcomes sought after have been obtained, a verification process becomes highly advisable, in order to ensure that everything has been properly done. Most methodologies are applied in a step-by-step forward sequence fashion; usually the checking up for their application is carried out in the same way.

This kind of checking-up is commonly satisfactory when used for repetitive and well-known projects. However, when the improvement process is highly unique and shows mostly uncommon features, a special checking-up needs to be carried out in order to spot any overlooked details. Most research projects fall into this category of endeavors and, consequently, must be subjected to an exhaustive checking-up. To this end, the author suggests the application of a retrospective analysis of the applied methodology, starting with the outcome of the last step carried out and proceeding later with the previous one, ending-up this sequence of analysis with the first step of the methodology. The set of questions posed below illustrates a retrospective checking-up.

5.8.1 Results and activities

Are the results obtained equal to the expected ones? Is it important to know why?
Is it necessary to review how the activities performed yielded their results?
Are there unexplained variations in the results obtained? Please specify.
Are there any results missing due to missing or incomplete activities?
Does each step of the method applied include at least one activity?

5.8.2 Activities and methods

Have any of the methods been applied differently from its validated fashion?
Do all the activities performed belong to a validated method?
Is it necessary to include an additional method to cater for one (or more) free-standing activities?
Have all the selected methods been applied fully and meticulously?
Has it been necessary to modify a proven method in order to obtain the results required?
How was this modification of the method validated?

5.8.3 Methods and objectives

Is it necessary to review how each step of the method applied leads toward the achievement of the objectives?
How have you checked the effectiveness of each selected method for yielding its corresponding outcomes?

5.8.4 Objectives and attributes

Have you checked the process where the changing of undesirable attributes (of the situation being improved) implies the achievement of the objectives established?
How have you verified that the objectives pursued fully include the new attributes sought in the situation being improved?
Have you also obtained some undesirable new attributes? Should they be ignored or eliminated?

5.9 Drawing your conclusions

5.9.1 Concerning the general objective

How was the achievement of the general objective verified?
Was this achievement performed as originally planned?
Is it necessary to report the differences between the expected outcomes?
Did you obtain unforeseen or deficient achievements on the general objective?
If yes, please specify.
Do they affect the validity of this work?
Will you need to perform any supplementary activities?
If so, please mention them.

5.9.2 Findings concerning the specific objectives

How was the achievement of each specific objective verified?
Was each objective achieved as originally planned?
Did you obtain unforeseen or deficient achievements on any specific objectives?
Could you mention them?
Do such variations affect the validity of this work?
Will you need to perform any supplementary activities?
If so, please mention them.

5.9.3 Unexpected outcomes

Did you obtain any unexpected outcomes on this project work?
If so, please mention them and state their relevance.
Do such findings affect the validity of this work?
Did unexpected outcomes generate additional activities?
If so, please mention them and state their relevance.

5.10 Suggestions for improvement

5.10.1 Supplementary activities

Is it necessary to include any suggestions to the improvement team in order to ensure the achievement of the expected outcome? If so, please state them.
Is it necessary to suggest any supplementary project for a substantial increase in benefits and impact?
Would it be possible to make extensive conclusions about this work compared to other similar projects?

5.10.2 New development needed

Which intellectual tools would be required to improve the quality and/or effectiveness of the improvement method depicted in this guide?
Which new knowledge is required to enhance the comprehension of the situation under examination?
Are there any theories, models, laws or standards that could improve the method depicted in this guide?

6. ORIGINAL RESEARCH WORK

The objective of this chapter is to introduce the analyst to the main concepts concerning original research work in the academic environment [15].

6.1 FUNDAMENTAL CONCEPTS

An original research project is a research endeavor that has not been previously performed. The block diagram below shows the main steps to be carried out to prepare a research proposal (Fig. 4).

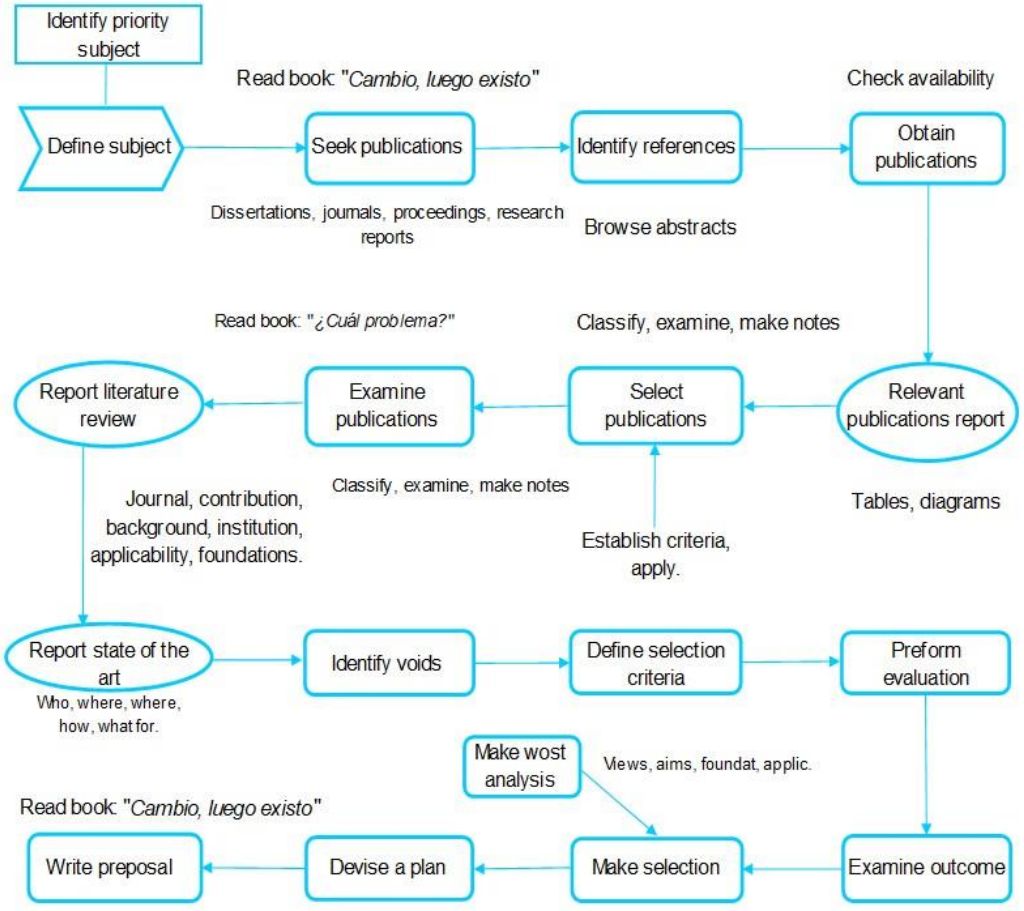

Fig. 4. Main steps to prepare a research proposal.

It all begins with identifying a subject of interest and our intellectual capabilities to deal with it. That is to say, our level of knowledge should be good enough to achieve a full understanding of all pertinent specialized literature, as well as of the related research methods on the subject chosen.

As it is customary in academic research work, every activity performed should yield a product (notes, ideas, diagrams, tables, questions, mostly), as the previous diagram shows. There are three milestones at the beginning of this inquisitive process, namely: a relevant publications report (progress achieved), a literature survey report,

and a state-of-the-art report. The absence of any of these reports is usually an indication of lack of objectivity, poor work organization and/or wasteful use of resources.

6.2 Frontier of knowledge

It constitutes the most advanced knowledge on a given topic. The main objective of original research work is to contribute new knowledge to move this frontier forward.

Doctoral dissertations report the outcome of original research work that makes one or more contributions to the frontier of knowledge.

6.3 Bibliographic research

It is a research work aimed at finding, locating, acquiring, analyzing and reporting all existing documents dealing with a prospective research topic.

6.3.1 Sources of original knowledge

Original knowledge is the outcome of original research work and is published in specialized journals. Each journal has an editorial board that examines each prospective article in terms of pertinence, originality, content, structure, methodology, readability, and contributions to current knowledge before its publication is approved. Usually, original knowledge is internally reported by a research team, as part of the progress reports within the institution financing or managing the research project.

Parts of the findings are often presented at academic congresses for quick dissemination and/or to get valuable feedback from other colleague researchers who perform similar work. This tends to enrich many projects, ease further progress, and yield some savings of time and resources. It may also give rise to mutual support and new joint endeavors.

Presentations at a congress are usually published in a book of proceedings, together with a roaster of attendees. Separate books may also be published with a set of selected presentations on a particular topic of interest.

6.3.2 State of art

Constitutes the ultimate progress achieved on the knowledge of a given topic. It is also known as the last frontier of knowledge for a topic being examined.

It usually takes the form of a report stating its nature, its essence, its importance, and some likely consequences of its findings, the authors of the contribution, the supporting institution, and further research to enhance or supplement the one being reported.

New research endeavors ought to start whit the certainty of where current knowledge is so that no resources are wasted on rediscovering something that is already known. Some findings, however, owing to their great importance, may require some checking up of the evidence being reported, their interpretation and/or the methods used for obtaining them.

State of the Art reports are usually written in a specialized language since they are addressed to researchers who are knowledgeable about the subject being examined. A complete and precise understanding of this report by a keen analyst may be a good indication that the reader is already fully conversant on the subject.

State-of-the-art reports have become keenly sought-after articles in their pertinent journals since they may save a considerable amount of effort and resources for newly arrived researchers who want to pursue a research project on a similar subject.

Journals also seek to publish this kind of article since their fellow researchers eagerly seek them.

6.3.3 Steps to establish the state of the art

Since a state-of-the-art report deals with the most advanced knowledge on a given subject, the text is written in a highly specialized language and in a rather accurate style. Therefore, the reader should be well acquainted with the subject to gain a proper understanding of such topics.

An advisable sequence of literature reading for someone who has just encountered a new and interesting subject to study could be as follows:

a) General purpose magazine dealing with a broad set of topics within a given branch of knowledge (engineering, medicine, economics, management, etc.). This is the first way to look for elementary knowledge when the analyst is dealing with a situation that is entirely new to her/his and it is just roughly specified and vaguely known. This elementary analysis usually ends up with a small report comprising some basic information on the core concept and its general context from most pertinent viewpoints.

b) Handbook on a given field of knowledge (civil engineering, mechanical engineering, industrial engineering, etc.). In this second step, the information gathered in point (a) before is used to look for a formal and deeper understanding of the knowledge required. A handbook provides general information on all the subjects contained within a specific field of knowledge, including its foundations, theories, principles, behavior laws, applications (machines, devices, tools), design, construction, maintenance, and disposal (decommission). The outcome of this analysis usually is a report depicting the problem to be solved, a general procedure to achieve its solution, the main resources needed, some explanatory diagrams, sources of additional knowledge required, etc.

c) General purpose books on specific subjects of a given field of knowledge (motion and time study, plant layout, production planning, plant location, etc.). The outcome of this analysis is usually a purposeful report dealing with a specific application depicting some problems solved, the calculations involved in the solving process, explanatory diagrams, construction drawings, operating instructions, processing plans, etc.

d) Dissemination magazines on practical applications of specific topics of a given subject within a given field of knowledge (process planning tool selection, machine replacement, etc.). The outcome of this reading is usually a small report addressing sources of formal knowledge and its applications, such as those referred to in points (a) and (c).

e) Specialized books on specific subjects of a given field of knowledge (practical plant layout, plant layout modeling, plant layout algorithms, etc.). This knowledge is used to improve the quality of the outcome produced through the application of knowledge cited in point (c) above.

f) Highly specialized journals on specific subjects of a given field of knowledge (modeling and simulation, systems sciences, forecasting techniques, applied statistics, etc.). The knowledge published in journals entails a substantial degree of originality as it approaches known situations in a new (better) way or addresses new conditions that have not been solved as yet. The outcome of this step takes the form of an internal report (in the project) or a research article. Articles reporting the state of the art on a specific subject belong to the journals included in point (f) of the list above.

Most of the knowledge acquired in the master course comes from publications cited in points (e) and (f) above, assuming that the students have already acquired their professional background through publications cited in points (a) to (d). Most students need an experienced advisor to acquire new knowledge.

Who needs to know the frontier of knowledge?
All those individuals wish to make a new contribution to it or want to be leaders in a given subject.

Why is it necessary to know the frontier of knowledge?
I want to be certain that a new contribution will be truly original and that the resources spent on such an endeavor will not be wasted.

Who holds the newest knowledge on a given field?
Highly specialized researchers are doing original work in that field.

How does anyone identify the frontier of knowledge?
By researching all pertinent publications, especially those dealing with highly original research work. In addition, it is possible to exchange information with world leaders on the topic of interest. Attending internationally acknowledged research conferences is highly advisable for getting acquainted with experts. Experts present frontier knowledge by stating its merits over previous contributions and showing the progress achieved in the fulfillment of specific knowledge voids.

REPORTING ORIGINAL RESEARCH WORK

The objective of this chapter is to provide the reader with some general information on the usual academic publications dealing with the dissemination of research work and its outcome.

7.1 INSTITUTIONAL REPORTS

These are mostly performed to comply with some internal regulations of a research institution and are addressed to a very limited audience.

Each report copy is allocated a code number and its circulation is strictly controlled and recorded, according to an established procedure.

Part of this report may be suitable for publication in a journal and/or for marketing purposes.

7.2 PUBLICATIONS

7.2.1 CONGRESS PAPERS

Congress papers are aimed at exposing current developments among fellow researchers in order to obtain valuable feedback from them and to promote mutual collaboration. The exchange of ideas may include, but is not limited to, methods, approaches, experiences, and findings.

The initial step to trigger the congress works is the call for papers, which is sent to prospective participants and published in most pertinent journals. This call was answered by interested participants who submitted an abstract of their prospective paper. Once the abstract has been evaluated, the organizers will send a communication to each participant to indicate the following steps to take.

Attending a well-known international congress constitutes an excellent opportunity for meeting global experts and establishing long-term acquaintances.

The set of papers accepted for presentation at the congress is usually published in a book called Proceedings.

7.2.2 ARTICLES

From an academic point of view, there are three types of articles, namely:

a) For information to the general public.
b) For triggering interest to learn more and consider application of novel methods, processes, materials, machines or knowledge.
c) For reporting the findings of original research work.

Most articles published in highly specialized journals belong to type (c) above.

7.2.3 BOOKS AND DISSERTATIONS

The structure and content of an academic book is established according to its purpose. Most books are meant to serve a set of professionals of a given branch of knowledge (managers, accountants, engineers, lawyers, etc.). A book with very wide content usually takes the form of a handbook containing introductory knowledge on a large variety of subjects within a given profession.

A reader seeking introductory knowledge on a given profession may be advised to begin with a handbook depicting such knowledge. A deeper understanding of each subject may then be obtained by examining the references cited at the end of each chapter of the handbook.

Most academic books have been written to serve the needs of the academic courses associated with their content, mostly at BSc level. Only a few books are meant for postgraduate studies. Good quality books tend to refer the reader to the original sources of knowledge (articles) for a deeper understanding of each of the subjects examined.

Generally, postgraduate studies are better carried out on the basis of a set of selected journal articles since most books tend to cite articles published two or more years before the book.

A good quality dissertation tends to cite up-to-date articles (less than one-year-old) and constitutes a good candidate to publish a novel book.

Doctoral dissertations are globally recorded and kept by University of Ann Arbor (Michigan), where keen researchers may access them through dissertation abstracts. http://www.dissertationabstracts.org. Citations of existing publications may be known through. http://www.citeseer.org.

8. RESEARCHER BIAS

The objective of this chapter is to introduce the reader to the different types of biases that a researcher may incur throughout the various stages of his/her research work. A researcher needs to prevent his/her intellectual bias which may invalidate his/her research findings [16].

8.1 General concepts

An analyst can't achieve a complete and accurate perception of reality since his/her perception process is naturally limited by his/her senses, which constitute the interface with the object being observed. It is obvious that each individual is endowed with different perception capabilities through his/her senses; consequently, his/her perception of reality is bound to be unique and exclusive.

For the purpose of this publication, the author suggests defining research bias as the creation of an incomplete and distorted mental image of a subject under observation, regardless of whether this happens with or without the will of the observer.

It is only natural for an observer to show a trend to perceive a process (incoming data) according to his/her own subjective interest, as well as his/her processing capabilities and possibilities for acting upon such mental image.

Ideally, an objective researcher should be endowed with a complete and accurate perception of the subject (phenomenon) under examination so that his/her research endeavor could be started without any bias. This part of the book analyses the most common biases so that a conscientious researcher may be aware of them and try to prevent their occurrence.

8.2 Research stages and biases

The perception of a situation by an analyst depends mainly on particular factors such as sensitivity, pertinence, interpretation, and meaning. This is illustrated by Table 5, which is shown below for ease of analysis. In the context of this book, data may become information once they have been decoded and interpreted.

TABLA 5. DATA COLLECTION AND PROCESSING.

DATA PERCEPTION		DATA DECODING		DATA INTERPRETING	INFORMATION MEANING
DIRECT	RECORDED	DECODING TYPE	CULTURAL	DIRECT / AIDED	TRUTHFUL
			CONTEXTUAL		
AIDED			DESIGNED		
			HIDDEN		DOUBTFUL
MISSED	NOT RECORDED	NOT DECODED	UNKNOWN	NOT POSSIBLE	NON-EXISTENT
			NONE		

Highly original research work often requires novel coding-decoding methods for a complete and accurate interpretation of the data observed once the analyst has made sure that nothing has been missed or distorted in a previous stage. Coding-decoding methods are particularly exposed to bias.

Data classification and data organization are also liable to bias. The simplest way to classify data is in terms of their relative importance, which may be essential, necessary, supplementary, or irrelevant. An objective classification system may prevent bias, provided that effective classification criteria are established in advance so as to prevent subjective prejudices from misleading the process. Data organization should be performed to yield evidence about the hypothesis being tested by letting data appear naturally and to promote the observation of hidden variations, trends, and patterns.

Bias in data decoding may become evident by checking the performance of the decoding system with different well-known data sets before the decoding process is applied to a novel data set. Checking the interpretation process can be performed in a similar way. Regrettably, this kind of checking will not be possible when the analyst experience is limited. Although the guru´s experience may be accessible, controlling the ego of some contributors may pose a real challenge to the project manager and promote another kind of bias.

The subsequent steps to perception, such as decoding and interpreting, are liable to introduce some bias:

a) Diagnostics
b) Elaboration of action plan (including allocation of resources and feasibility analysis).
c) Implementation of action plan (intervention).
d) Evaluation of outcome.
e) Follow-up activities.

In each of these steps, the analyst is liable to incur upon some kind of bias.

8.2.1 RESEARCH WORK NEEDED

A preliminary research work carried out by the author on the subject of bias has made it evident that bias prevention is not routinely performed in most research projects. Such omission should raise some concern among the stakeholders of those projects, according to their likely consequences. Only a few authors of journal articles make explicit references to the possibility of existing biases and their prevention in their research reports.

This author contends that every research work should make explicit and conscientious efforts to examine likely causes of biases throughout its various stages of development.

8.2.2 BIAS TYPES

The most common bias types found in academic publications tend to be the following:

a) Omitting, averting, and neglecting (intentionally or unintentionally) data, information, perspectives, and sources.
b) Prejudices (consciously or unconsciously) of a researcher.

c) Intentional distortion of data, information, procedures or outcomes.
d) Reporting of non-existent evidence.
e) Insufficient, inaccurate, or meaningless reporting of events or results.
f) Loosely supported or unclear conclusions.

It is evident that the presence of any of these bias types on a report, a paper, an article or a book leads the reader to speculate on the validity of the whole document being examined.

8.2.3 WIDELY KNOWN CASES OF BIAS

Global media made widely known some cases where researchers incurred some serious biases that eventually eroded their credibility and affected many individuals. See the table 6.

TABLA 6. CASES OF BIAS.

CASE	COMMENT	TYPE OF BIAS
Development of AIDS Vaccine	Falsely claimed by researchers	Reporting of non-existent evidence
Cold nuclear fusion achieved in a lab	Falsely claimed by researchers	Reporting of non-existent evidence
Indiscriminate automation of a car assembly plant	Lack of awareness of cultural implications	Intentional neglect of cultural feasibility
Development of high-productivity seeds	Distortion of food production cycles	Misguided evaluation of benefits achieved
Development of ergonomic furniture	Falsely claimed to prevent fatigue	Mistaken selection of potential users

In some of these cases, the researchers were awarded a research prize which had to be revoked when the false claims were discovered. In other instances, most affected stakeholders have been unable to get paid for the damages caused.

8.2.4 REFERENCES ON REPORTED BIASES

A preliminary literature survey performed by the author, made evident the following facts:

a) Bias occurrence in research work is seldom reported and, maybe, poorly prevented. Institutional pressure to show results is likely to be a major cause for this failure, but it has not been properly investigated.
b) Only a handful of researchers acknowledge the possible existence of some bias in their work and take action to prevent it.

c) It becomes essential to include a bias-checking procedure in every research project in order to ensure the high quality and effectiveness of all its outcomes, as well as their applications. Scarce resources should be managed wisely.

Readers wishing to increase their knowledge of biases in academic research are invited to explore some pertinent publications enlisted in the references section of this guide.

8.2.5 Suggestions for bias prevention

The more original a research work is, the more exposed it becomes to unpredictable situations. Most biases stem from loosely selected methods or falsely (unsupported) reported claims, which are more likely to occur when the researcher moves into unexplored knowledge-seeking paths.

Self-checking of every step made by the research team becomes mandatory to prevent bias from occurring. For this purpose, the reader is advised to work out some guiding instrument prior to performing key steps of his/her research project, such as table 7.

Table 7. Bias Prevention Checking.

PROJECT STEP	LIKELY BIASES	PREVENTIVE ACTIONS	REPORTED INCIDENCES
Perception			
Decoding			
Referencing			
Diagnosing methods			
Diagnosing current situation			
Cause-consequence analysis			
Identifying required changes			
Evaluation of effective actions			
Situation changing methods			
Situation changing plan			
Benefits /costs evaluation			
Sensitizing of stakeholders (american english)			
Implementation of action plan			
Outcome evaluation			

ANNEX A. GENERAL QUESTIONS

The table 8 shows widely acknowledged connotations for the main keywords used for posing effective questions, as well as their suggested sequence of use [17].

TABLE 8. CONNOTATIONS FOR MAIN KEYWORDS.

KEYWORD	CONNOTATION	SEQUENCE
HOW?	Methods or procedures for achieving objectives	5
WHO?	Stakeholders, analysts, managers	6
WHY?	Justification, background, consequences.	4
WHAT FOR?	Purpose, objective, requirement, reason	3
WHAT?	Object, subject, action	1
WHICH?	Attributes of an object, subjects	2
HOW MUCH?	Amount of change, resources needed	Jointly with 2 and 3
WHEN?	Timing of action, achievement, key event	Jointly with 3

The main stages of an improvement process usually tend to be the same in a wide variety of instances, namely:

a) Spotting an abnormal situation. What should be observed? How? What for?
b) Verifying improvement requirements. Is it really abnormal?
c) Knowing most general aspects of the situation. What do the records show? How has the context changed?
d) Establishing general knowledge requirements. Do I know all I need to? What else do I need to know?
e) Obtaining additional knowledge is required. Where could I find it? How could I get it? Will it be enough?
f) A detailed analysis of the situation needs to be improved. Do I have all the required observation and intellectual tools? Where and how could I get them? Do I need specialized advisers?
g) Establishing the requirements of additional specialized knowledge/expertise. What do we ignore, how do we obtain it, how should we apply it?

h) Obtaining additional specialized knowledge/expertise. Where is it found? How is it obtained? Will it be sufficient?
i) Implementation of selected methods for achieving the objectives pursued. Who and how should they be applied? What should each step yield?
j) Analysis and evaluation of achievements. Have we achieved all we needed? Has it been on time and with the allocated resources?

The above questions aim to provide some general guidance to the reader/analyst. Most improvement methods include some kind of progress checking critical stages of their application providing some kind of feedback towards selected previous steps whenever the results achieved are not satisfactory.

For example: newly applied knowledge yields better results which, once they are evaluated may be judged as satisfactory or, yet may call for more knowledge to yield better results.

Some of the concepts, methods, and questions depicted in this publication may seem obvious to a reader once they have been examined; however, it is pertinent to point out the following:

a) Detecting the improvements needed is always insufficient for devising and implementing practical actions. Availability of resources and infrastructure, as well as feasibility within the surrounding culture, plays a crucial role in the success of any project.
b) The level of expertise required for applying the initial steps of the methodology chosen tends to be less knowledge-demanding than the essential and evaluating steps that follow.
c) An improvement process is, by its very nature, of an iterative kind. Each iteration yields new outcomes and findings which, once regarded satisfactory, may indicate to the improvement team that the next step should be carried out. Early and observable improvements are desirable, at an acceptable outlay of resources, in order to promote goodwill among stakeholders, provided that essential aspects are never neglected.

APPENDIX A
INTRODUCTION TO PROBLEM – SOLVING [18]

What is it?
Problem-solving is a process carried out in a situation that shows some unsatisfactory performance, whereby a purposeful intervention is devised and implemented to improve or change its deleterious attributes.

What is the essence of problem-solving?
Its essence lies in changing the process behavior for the better or exchanging some of its endowed attributes for more suitable ones.

When is it necessary?
It is applied to a production entity (goods/services) when it does not behave as required or does not achieve its goals and objectives.

Where is it performed?
It is applied to an object or process element which does not yield its expected outcome.

How is it carried out?
It is advisable to perform it using well-proven methods. Suitable and specific methods should be preferred over general-purpose ones. It should be borne in mind that a method is: a sequence of steps to be carried out for achieving something (goals, objectives). Usually, a method is deployed as a purposeful network of activities that generates the outcomes that jointly achieve the objectives sought.

Frequently sought objectives are solving a problem, improving a situation, implementing desirable changes, and acquiring previously inexistent knowledge.

APPENDIX B
STAGES OF PROBLEM-SOLVING

Problem-solving is often approached as an improvement project, comprising the 10 stages mentioned below:

1) *Establish the current situation*. A brief process description is required so that all stakeholders have a shared understanding of the process being examined. Afterward, the participants' attention should be driven, through objective observations, towards critical aspects of the process that largely determine its satisfactory performance from different but supplementary, points of view.
2) *Performance indicators and references*. Qualitative and quantitative performance indicators, as well as their references, need to be introduced by the leader analyst in order to focus the analysts' attention on likely problem areas and undesirable aspects.
3) *Preliminary assessment*. It aims to justify the analysts' efforts towards the situation under examination, as well as confirm the suitability of their analysis methods and the sufficiency and quality of the information available for a thorough situation assessment. A checklist and a survey could be used at this stage to obtain suitable indicators that may lead the team actions in a fruitful direction.
4) *Detailed process description*. As the analysis evolves towards a thorough and transcendental stage, the information requirements of the analysts also grow in both quality and quantity. Likewise, objectives and methods may call for improvement in their focus, precision, and pertinence. Which, in turn, are likely to pose new requirements on information, strategies, and other resources.
5) *Detailed current performance evaluation*. It consists of a complete and accurate assessment of all elements of the process under review from all relevant points of view and for a variety of likely scenarios.

   A wise combination of assessment methods may be required to ensure an objective and practical evaluation. Occasionally, a new method may have to be developed and tested for an adequate review.
6) Diagnostics. This stage consists of a detailed analysis of the outcome produced in stage 5. It calls for an adequate diagnosis method that can show:

   The way in which the process being examined has evolved from an originally satisfactory performance down to the poor situation that is showing now; How this degradation has taken place; finding out the factors that have caused and promoted this deleterious change.

   Which consequences are likely to occur as a result of the bad performance stemming from the current situation? An exhaustive literature survey has shown that there is no single method covering the four requirements shown above. However, the concept of the system may be applied for examining the way in which a situation has arisen and evolved toward its current state. From the concept, a system is a set of interrelated elements having a common objective to which they all contribute.

   From its very conception, a system is devised to perform a given function in a prescribed way, under a known set of circumstances, through the utilization of some allocated resources. Consequently, when the system does not perform as expected, most analysts begin their troubleshooting by examining possible changes in prevailing circumstances, deficiencies in the resources allocated, and changes in the relationships between the constituent elements of the system. Of course, the obvious way to do this is through a detailed examination of the entire process, the end product of which is the system under analysis.

   An alternative method for finding out what has gone wrong in a system performance could be the development of a causality network, which begins by establishing all the observable failures of a situation and ends up with the identification of their root causes, as shown in the FINICIO diagram (Oliva, 1999). The author contends that an in-depth analysis should examine all the consequences of the system's behavior. Therefore, a causality-consequence network should be developed to gain a deeper understanding of a system's behavior; this will enable the decision-makers to allocate scarce resources where the most beneficial ratio can be obtained.
7) *Development of an action plan*. A good quality diagnostic indicates how the current situation could be improved and which changes need to be implemented to obtain a satisfactory performance of the system that needs improvement within a constrained availability of resources. This can usually be performed through the development of an activity network devised with the critical path method (CPM).

8) *Deployment of an action plan*. The actual deployment largely depends on the availability of resources and the risks involved. The ideal circumstances for deployment are usually absent, resources are always constrained, and risks change over time. Consequently, some adjustments should be expected over the lifetime of the improvement project.
9) *Establishing of the new situation*. Once the action plan is finished, the improvements sought should be checked up and documented until they become the new normal and are widely accepted. Previous troubles should not prevail, and minor adjustments are likely to occur.
10) *Reporting and follow-up*. Experienced managers would agree that no system is ever trouble-free, and unattended small and simple problems quickly grow into large and complex ones. New systems, new reporting, new habits, new tools, new perspectives, new market dynamics, new trends, new resources, and new approaches call for permanent attention by all stakeholders.

The ten items described above may make it seem that the analysts are investing too much effort in solving a common problem. However, after performing a large number of projects on a large variety of disciplines, most analysts have found that trivializing a problem or its solution leads to an excessive expenditure of resources, frustration and a larger and more deleterious situation.

TRIVIAL APPROACH

Implementing corrective actions is often misunderstood as actual problem-solving, thus ignoring all the stages required for a successful intervention. Unsupported interventions tend to require excessive resources and do not provide the urgently needed success. Nonetheless, a desperate manager and immature analysts are often tempted to rush into the implementation of quick-and-easy actions, which are not likely to yield the anxiously expected outcome and can only worsen the situation faced.

Experience has shown that a hasty intervention usually solves some part of a situation but, more often than not, ends up creating new undesirable attributes which, in turn, call for an additional expenditure of scarce resources.

REFERENCES

[1] R. Fernández, H. A. Simon, "A study of how individuals solve complex and ill structured problems," *Policy Sciences*, vol. 32, no. 3, 1999, pp. 225-245, https://doi.org/10.1023/A:1004668303848
[2] D. Fensel, E. Motta, "Structured development of problem solving methods," in *IEEE Transactions on Knowledge and Data Engineering*, vol. 13, no. 6, pp. 913-932, 2001, https://doi.org/10.1109/69.971187
[3] L. Zhang, X. Xu, "Developing Real Life Problem-Solving Skills through Situational Design: a pilot study," *Education Tech Research*, vol. 67, pp. 1529–1545, 2019, https://doi.org/10.1007/s11423-019-09691-2
[4] A. Maltz, A. Shenhar, R. Reilly, "Beyond the Balanced Scorecard: Refining the Search for Organizational Success Measures," *Long Range Planning*, 2003, pp. 187-204.
[5] T. Finlow-Bates, B. Visser, C. Finlow-Bates, "An integrated approach to problem solving: linking K-T, TQM and RCA to TPM". The TQM magazine, vol. 12, no. 4, 2000, pp. 284-289, https://doi.org/10.1108/09544780010325912
[6] M. Rother, J. Shook, *Learning to see*, The Lean Enterprise Institute: Brookline, Mass., USA, 1999.
[7] S. Pokras, *Cómo resolver problemas y tomar decisiones sistemáticamente*, Grupo Editorial Iberoamérica: México, 1992.
[8] S. Hance, D. Huges, D. *Surviving Fads, Fashion and Folderol*, Center for Values Research: Dallas, Tx., USA, 1996.
[9] E. Cameron, M. Green, *Making sense of change management: a complete guide to the models, tools and techniques of organizational change*, Kogan page Ltd: UK, 2009.
[10] M. Crubézy, W. Lu, E. Motta, M. A. Musen, Configuring Online Problem-Solving Resources with the Internet Reasoning Service. In: Musen, M.A., Neumann, B., Studer, R. (eds) *Intelligent Information Processing. IIP 2002. IFIP — The International Federation for Information Processing*, vol 93. Springer, Boston, MA. https://doi.org/10.1007/978-0-387-35602-0_9

[11] B. Keats, M. A. Hitt, "A Causal Model of Linkages among Environmental Dimensions, Macro Organizational Characteristics, and Performance," *The Academy of Management Journal*, vol. 31, no. 3, 1988, pp. 570–98. https://doi.org/10.2307/256460

[12] M. Lewis, "Cause, consequence and control: towards a theoretical and practical model of operational risk," *J. of Operations Management*, vol. 21, no. 2, 2003, pp. 205-224, https://doi.org/10.1016/S0272-6963(02)00071-2

[13] A. Oliveira, *Effective Tools and Problem-Solving Methods for Manufacturers*, proactioninternational.com, 2024, https://blog.proactioninternational.com/en/problem-solving-methods-for-manufacturers

[14] M. Spector, D. Merrill, J. van Merrienböer, M. Driscoll, *Handbook of research on educational communications and technology*, 3rd ed., Erlbaum Editors: USA, 2008.

[15] M. R. Gearty, J. Marshall, "Living Life as Inquiry - A Systemic Practice for Change Agents," *Systems Practice and Action Research*, vol. 34, no. 4, pp. 441-462, 2021, https://doi.org/10.1007/s11213-020-09539-4

[16] J. H. Barnes, "Cognitive Biases and Their Impact on Strategic Planning," *Strategic Management Journal*, vol. 5, no. 2, 1984, pp. 129-37, http://www.jstor.org/stable/2486172

[17] J. Axe, S. Phelan, C. Irwin, "Empirical Evaluations of Skinner's Analysis of Problem Solving," *Anal. Verbal Behav.*, vol. 35, no. 1, 2018, pp. 39-56, https://doi.org/10.1007/s40616-018-0103-4

[18] B. Rott, B. Specht, C. Knipping, "A descriptive phase model of problem-solving processes," *ZDM Mathematics Education*, vol. 53, 2021, pp. 737-752, https://doi.org/10.1007/s11858-021-01244-3

Científica, vol. 28, núm. 1, pp. 01-36, enero-junio 2024, ISSN 2594-2921, Instituto Politécnico Nacional, MÉXICO
e280110 | DOI: 10.46842/ipn.cien.v28n1a10