The Nature of Hard and Soft Problems and Their Problem-Solving Perspectives

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A B S T R A C T

Problem-solving requires adopting an appropriate approach that is influenced by understanding the nature of problems ranging from soft to hard. Research results indicate that there is still a lack of an accurate understanding of the nature of problems while researchers are engaged in adopting an approach to addressing the problems. Therefore, this research seeks to investigate the nature of hard and soft problems and the quality of their resulting solutions. This research endeavors to examine the nature of soft and hard problems. It is believed that identifying the attributes of different types of problems helps strike a balance between the nature of the problem, the problem-solving method, and the methodology used. Therefore, this research has addressed the nature of hard and soft problems and their perspectives on solving problems to fill gaps left in systems thinking studies. Also, current research helps researchers set a balance between attributes of the problem and ways of thinking about it, better identify the nature of the problem and better adapt the methodology to the problem. Based on the results of this research, soft problems are influenced by the context of the problem. In addition, in hard problems, the structure of the solution is determined by the problem structure. In contrast, in soft problems, the structure of the solution demands a proper understanding of the logical and cultural phenomena of the problem context. That is why the quality of the answer to hard problems is a normative, right, and definitive solution, while the answer to soft problems is a procedure composed of concepts and meanings. The findings of this study suggest that, like a soft problem, the solution to a soft problem is a social reality that all interested groups collectively enact. Consequently, the solution is a system of concepts that all the interested groups accept, and over its implementation, there is a shared understanding among all the interested groups.

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1. Introduction

The problem acts as an impediment to achieving the objective or purpose. Jonassen (2000) considers the problem an unknown entity in a situation that creates value for the problem solver if he/she can find such an unknown entity. In Jonassen's (2000) view, problems are defined in 3 distinctive dimensions. 1- Structuredness 2- Complexity 3- Abstractness. Structuredness refers to the relationship between problem attributes and the surrounding parameters of the problem (Jonassen, 1997, 2000). These parameters can constitute problem attributes, the diversity of relationships between problem components, and how a problem is defined. Structuredness is more related to the availability of information and contextual richness.

Complexity is associated with the number of problem attributes and the degree of connectivity among these attributes. If there is a surge in the number of these attributes, the problem becomes more complex. Abstractness (domain specificity) is also related to the generic nature of the problem and its universal characteristics. If the degree of abstractness of a problem is low, problem-solving activities are more situated. The interaction of these three dimensions plots the problems on a continuum of hard to soft. Hard problems are structured, typically simple, and less complex, and their continuum is generic and abstract. Some research has referred to the situation of these problems as a puzzle. Thus, in this manuscript, hard problems are considered equivalent to puzzles (Jonassen, 1997, 2000; Pidd, 2003; Revans, 2011; Segal, 2004), structured problems (Voss, 1988), or tamed problems (Conklin, 2005; Rittel and Webber, 1973). The abstractness of this set of problems facilitates the definition of these problems; moreover, the root cause of the problem is known to us or can be easily uncovered. This set embraces context-free problems in which the stopping point of the answer is evident (Rittel and Webber, 1973), and there is general agreement on the success of finding a solution to the problem (Conklin, 2005). Therefore, such a set of problems have one single best solution.

Further, it is also possible to solve them by recruiting programmed knowledge. Knowledge was extracted from solutions that followed an orderly and linear 'top-down' process, working from the problem to the solution. In hard problems, the criteria for evaluating the solution are well-defined and can be determined as either correct or incorrect.

Soft problems are the opposite of hard problems. This set of problems is unstructured, have a complex nature, and is tied to the context. In this paper, soft problems are perceived as equivalent to messes (Ackoff, 1974; Novick and Bassok, 2005), ill-structured problems (Simon, 1973; Voss, 1988, 2014), ill-defined problems (Chi et al., 2014; Eastman, 1969; Reitman, 1964) or wicked problems (Churchman, 1967; Conklin, 2005). The complexity of these problems has

inspired researchers to examine the nature of these problems in various respects. Different researchers have addressed soft problems from a wide variety of perspectives, for example, from an information processing perspective (Newell and Simon, 1972), from the planning and policy-making perspective (Rittel and Webber, 1973), from a management systems perspective (Checkland, 1994) and also from a psychological perspective (D'Zurilla and Nezu, 1999; Kitchner, 1983; Mayer, 1992; Voss, 1988, 2005; Voss et al., 1983).

It is noteworthy that researchers have a consensus that it is not easy to define soft problems and explore the boundaries, variables, and objectives of these problems. Therefore, numerous and sometimes contradictory definitions of a soft problem are available among problem solvers. On top of the fact that there are no identical interpretations of the definition of the problem, the methods for finding the solution to soft problems are not straightforward. In such cases, as Simon (1959) points out, as a consequence of human cognitive capacity limitations, decision-makers and problem solvers would rather have solutions that are not necessarily rationally optimal but are considered satisfactory. Therefore, in this set of problems, the criterion for finding the answer is not lucid enough, and the problem solvers are usually pleased with satisfactory solutions (Simon, 1976). Since the problem-solving in this set of problems departs from the rational approaches and turns into a cognitive one; therefore, the criteria for evaluating the results of this set of problems are tied to values, beliefs, faiths, behaviors, and contradictory certitudes. Accordingly, instead of the quest for right or wrong answers, evaluation is carried out by considering better, worse, or somewhat good criteria (Edmonstone, 2014). Furthermore, soft problems are characterized as the creators of other soft problems because an attempt to solve one aspect of soft problems can create and reveal other soft problems (Rittel and Webber, 1973).

It is worth mentioning that given the importance of soft problems in social sciences and management, identifying their dimensions can promote a better understanding of these problems and, consequently, have a significant impact on solving them. Creswell and Clark (2007) articulate that the researchers' philosophical assumptions influence research studies. Hence, it can be contended that if the researcher is not fully aware of the nature of a problem and its philosophical assumptions, (s)he might mistakenly recruit methods and methodologies in solving and confronting the problem. Therefore, it is paramount to understand the differences between different types of problems because the nature of the problem helps the researcher define the problem, pick out the appropriate approach to address the problem, and set up the research process. This issue is of high significance, in particular, in soft problems, because the

misperceptions and misunderstandings observed in the secondary literature on the nature of these problems demonstrate that appropriate methodologies for addressing these problems have not been applied (Checkland and Poulter, 2006; Hanafizadeh and Mehrabioun, 2017; Holwell, 2000). With that in mind, the first question can be formulated as follows.

1. What is the difference between the nature of soft and hard problems?

For this reason, this research examines the nature of soft and hard problems. It is believed that identifying the attributes of different types of problems helps strike a balance between the nature of the problem, the problem-solving method, and the methodology used. It can also narrow down the disparity and incommensurability between methodology and the nature of the problem. In some cases, the problem under study may not be hard; thus, the researcher's use of hard problems' problem-solving approaches premised on abstraction has confounded the nature of the problem and posed a new problem rather than solved the problem.

On the other hand, it is essential to discretely investigate the difference in the quality of solutions for hard and soft problems. Such an investigation leads to researchers' expectations of the solutions being properly articulated, and their aim of problem-solving is precisely defined. The question that may arise is the difference between the results of solutions for hard and soft problems. Can we expect the same answers? If different results are accumulated, which of them is correct? Therefore, an account of the difference in the quality of solutions for hard and soft problems merits further investigation. Therefore, the second question of this research is:

2. What is the difference between the quality of solutions in hard and soft problems?

This research is organized into six sections. The second section examines the nature of hard and soft problems. The third section responds to the second question of the research and seeks to examine the difference in the quality of solutions to hard and soft problems. The fourth section summarises the differences between soft and hard problems. Discussion is presented in fifth section. Finally, the conclusion and implications are discussed.

2. Hard problems

Hard problems are entirely structured and for which there is a definitive optimal solution. Hence, there are common and consistent interpretations of the solutions to this set of problems, and applying mathematical and statistical methods to solving these problems is commonplace (Pidd, 2003). According to Jonassen (2000), the structuredness of hard problems makes both the initial and desired states of problem-solving and the problem-solving procedures well-

known and well-defined. Another attribute of hard problems is their simplicity and abstractness. This simplicity stems from the sustainability of the components of the problem over time, which prompts the problem-solving process to confront a less cognitive operation on behalf of the problem solver (Frensch and Funke, 2014).

On the other hand, these problems are less contingent on the problem situation and require generalizable problem-solving skills such as economic analysis; consequently, they are less subjective and more objective (Jonassen, 2000). In hard problems, both the problem and its domain are definitive; there is also a general agreement on how success in problem-solving is determined (Conklin, 2005; Edmonstone, 2014). In this set of problems, those irrational behaviors and actions cannot be traced to humans in the event of uncertainty. Still, uncertainty is brought about by the inaccuracy of measurement tools and disruption in the problem's parameters. Information from uncertain parameters can be considered probable, stochastic, or even fuzzy. In hard problems, the problem solver is a rational individual with good judgment in setting parameters, prioritizing, weighing options and alternatives, and solving a problem. Hard problems are not necessarily simple problems. The diversity and multiplicity of its components can make the hard problem complicated. However, there is an existing knowledge base of tried and tested solutions to hard problems; further, there are solutions to such complicated problems. The solution to such problems follows an orderly and linear top-down process.

In hard problems, even if the dimensions of the problem are large, usually by adopting reductionism approaches, the researcher attempts to break down the big problem into smaller ones (see Figure 1). In the process of decomposing the big problem into sub-problems, the decomposition continues as long as the best solution can be employed for a sub-problem. Therefore, there is one best solution in the hard problem situation, corresponding to each of the smaller sub-problems. Hence, the answer derived from solving sub-problems has the desirable quality and can be used in the problem situation. The complexities that researchers encounter in dealing with hard problems involve 1) Understanding the structure of the main problem and structuring the sub-problems during the process of decomposing the main problem into sub-problems; 2) Assigning a single best solution to each of the sub-problems to solve them or developing an instruction/procedure for solving a sub-problem; and 3) Synthesizing, merging, linking, incorporating and integrating solutions to sub-problems in order to formulate the answer to the main problem.

Many human advances in science and engineering have successfully flown from reductionist

approaches. The answer to hard problems can be considered a right and definitive approach to the decision variables of the planning problem or the engineering design variables. The so-called' hard solution' is a definitive response to a decision or design variables.' The results of this series of questions are the best answer which illuminates the optimal decision-making solution in a prescriptive, normative, and obligative manner, and the decision-makers' guidelines for finding a solution are clear-cut. Since the assumptions and conditions considered for problem-solving instructions and the best methods of solving the problem are satisfied in the problem situation, concepts such as optimal solution, optimality, and the use of definitive attributes utilized to describe the quality of the solution to a problem are prevalent (Jonassen, 1997).

Similarly, the researcher's experience and innovation in understanding the structure and method of synthesizing solutions to smaller problems can be considered a model for similar problems. The best solutions developed for sub-problems are another output of the hard problem-solving process, the best and right method (Rittel and Webber, 1973). The reductionism approach that the problem solver encounter in hard problems is illustrated in Figure 1.
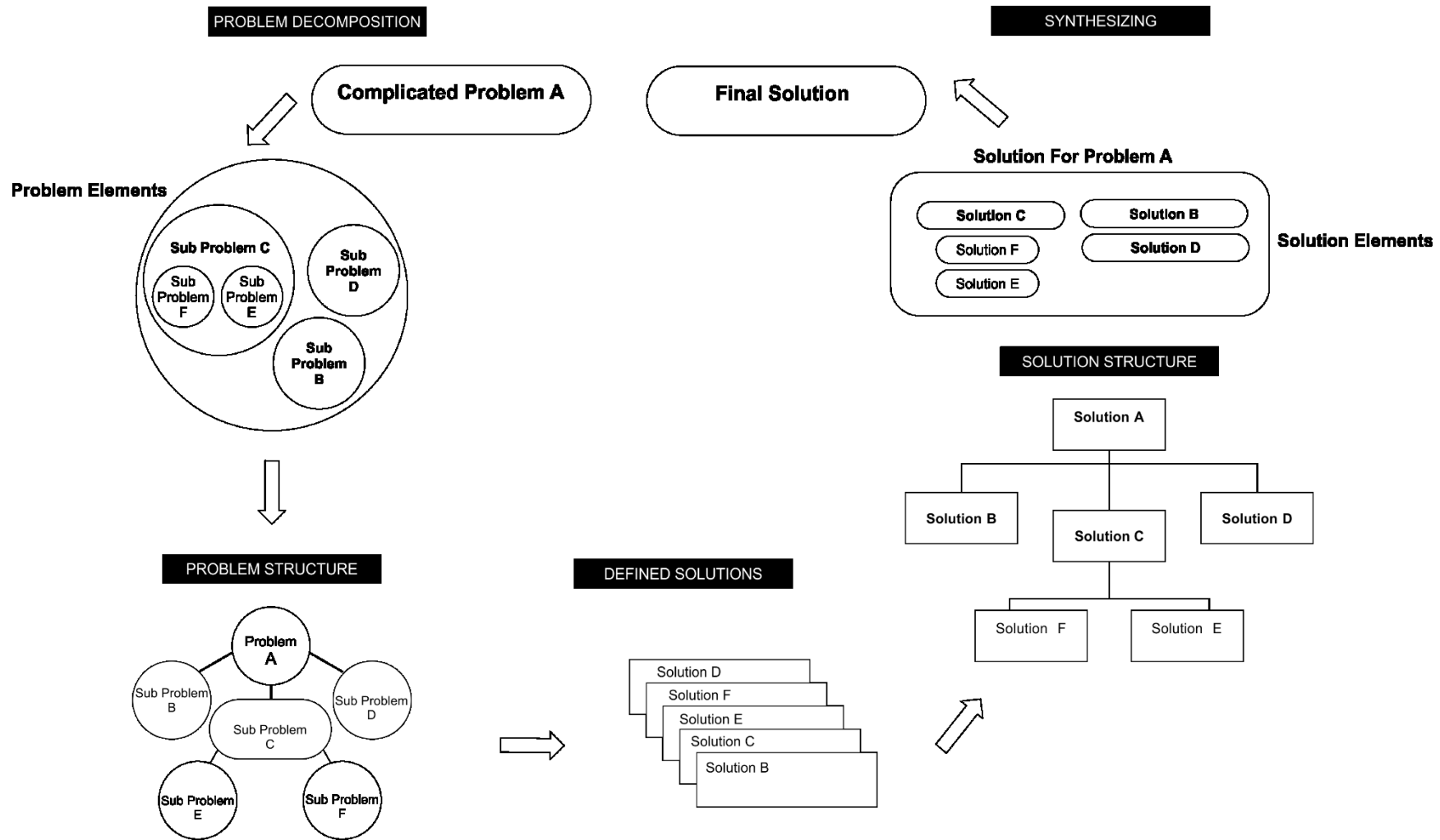
Figure 1. Solving approaches to hard problems

3.   Soft problems

Soft problems deal with problematical and messy situations in which the problem definition itself is perceived as a problem and depends on the individual impression. Soft problems are interlinked to situations in which both definition of the problem and how they are solved are vague (Pidd, 2003). The messy situation of soft problems is complex rather than complicated, dynamic rather than static, and each situation is viewed and interpreted differently and uniquely by the decision maker. In soft problems, the decision maker's perceptions of the problem situation impact the nature of the problem and its solution. In such situations, framing and defining problems that have brought about the mess is regarded as the most challenging and demanding step due to observers' multiple but defensible definitions (Mingers and White, 2010). Because of their social nature, soft problems face a flux of events and ideas that emerge over time. Such a flux creates a problematical situation that is not unique but dynamic and encompasses many conflicting and defensible worldviews. In such situations, the reality is envisaged as a construct of the human mind and is associated with human perceptions of the problem situation (Flood, 2010). Such perceptions require the attribution of meaning to the peripheral social structures (Checkland and Poulter, 2006; Yearworth and Edwards, 2014).

Notably, ambiguity and uncertainty increase in soft problems owing to disagreement on impressions, goals and problem-solving approaches. Thus, in this case, there is a surge in conflicts and differences among the interest groups involved in the problem situation; further, in addition to the content of the problem, the roles involved are also highly significant. In this state, rational decisions will not always lay the proper groundwork for successful and appropriate actions. Therefore, solving a problem is not a rational activity but a social action (Brunsson, 1985). Soft problems have enormous complexities because of their relationship with social situations and interactions with those who create them. One of the objectives of operations research is to tackle these complexities. The thinking about these problems is called soft systems thinking. Soft systems thinking which rests on the changing messy situation casts doubt on the legitimacy of hard systems thinking' view in solving human-oriented problems (Hanafizadeh and Mehrabioun, 2017). Therefore, the approach used to solve soft problems differs from that of hard problems.

3.1. The nature of soft problems

Soft problems must grapple with scant information resources, and their data are uncertain and incomplete (Edmonstone, 2014). Further, soft problems are ill-structured because some of

the components of the problem are unidentified. There are several criteria for evaluating soft problems, and assessing problems are also susceptible to personal beliefs and judgments (Jonassen, 2000). In addition to the lack of structure, soft problems are complex problems because the components of the problem change over time. Such changes arise because soft problems are closely related to human beings and social processes. According to Checkland (2005), social processes intertwine people's appreciative systems. Such systems have an impact on the way people make decisions about soft problems. Concerning Checkland's and Vickers's (1965) findings, individuals and groups have diverse experiences. These experiences follow their preceding interpretations, judgments, and perceptions and their reactions to new ideas and events. Such experiences lead to the formation of standards, values, and norms. Such standards and values direct the way individuals make judgments while dealing with problems in a manner that the same objective phenomenon is interpreted and judged differently from diverse perspectives. Such judgments serve as the source of actions in the real world. Such actions will also lead to a change in the real world and exert an influence on future experiences. Such a concept is illustrated in Figure 2.
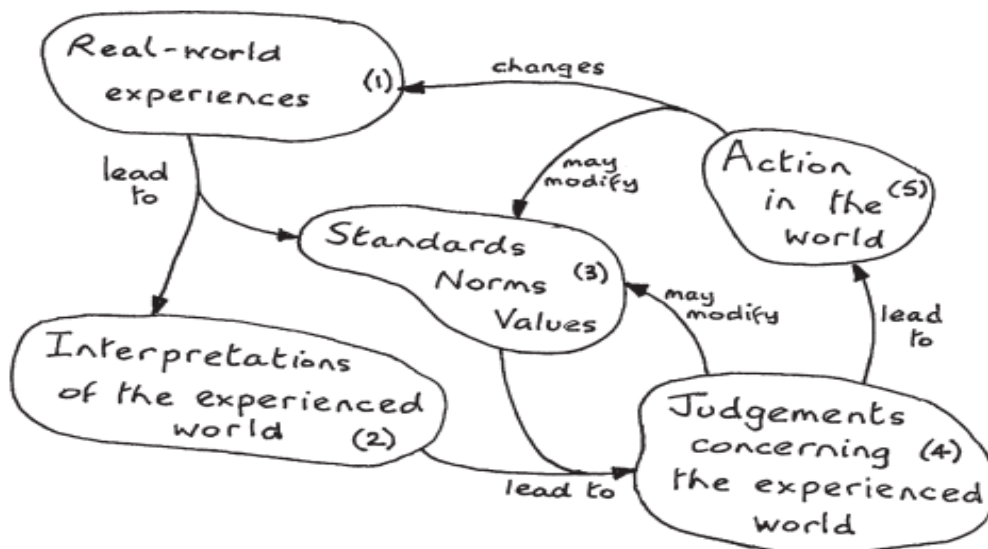

Figure 2. The dynamics of an appreciative system adapted from (Checkland, 2005)

According to Figure. 2, the reason for the complexity and dynamics of soft problems can be explicated as follows. As they are concerned with social processes, soft problems are affected by people's appreciative systems. That is why in the face of a soft problem as a new event, people with different backgrounds come up with diverse standards, values, and norms because they have different perceptions of the past and interpretations. Such differences lead to the formation of several judgments of the same problem, so everybody may have a different way

of interpreting the same problem. On the other hand, the multiplicity of standards, norms, and values prompts each person or group to take action to solve a problem; regarding their appreciative systems, such actions lead to a solution to the problem. That is why people have different priorities for problem-solving. Given the importance of appreciative systems in forming soft problems, solutions to soft problems should also consider standards, values, and norms.

Considering the influence of the previous background and experiences on the formation and solving of soft problems, the reductionism approach harms the nature of the problem because a problem originates in history and its past experiences. By disconnecting the problem from its context, reductionism approaches offer an analysis of the problem, regardless of its history and experience. Therefore, holistic approaches should be applied. According to Checkland (2000), a holistic approach should consider people's systems ideas while dealing with messy situations. The emerging property of these systems is purposefulness (Checkland and Poulter, 2010). According to Checkland and Poulter (2010) and Zexian and Xuhui (2010), understanding the purposefulness of individuals should draw on the identification of logical activities and ideal models. Therefore, it can be stated that the problem-solving of soft problems is defined by identifying individuals' systems ideas or ideal models (Hanafizadeh et al., 2017). Considering ideal models is consistent with Checkland and Poulter's (2010) view in analyzing the logical dimensions of the situation of the soft problem and the ideal model of individuals. Therefore, it can be claimed that one of the significant aspects of defining and solving soft problems is to objectify the ideal models of individuals and convert them into a logical phenomenon. The transformation of ideal models into logical phenomena provokes a better understanding of how people think about soft problems.

On the other hand, according to Checkland and Poulter (2010), in addition to the logical analysis of the problem situation, it is indispensable to consider its cultural aspects. As stated earlier, in social processes, people's perceptions of a new problem are influenced by their values. Values, norms, and social and cultural dimensions shape individuals' perceptions of the problem situation. Therefore, cultural phenomena should also be considered critical to understanding logical phenomena while addressing soft problems. Simultaneous attention to logical and cultural phenomena corresponds with Checkland's (2000) phenomenological view of confronting real-world problems. As phenomenology points out, all human activities in the real world rest on thinking about the real world rather than the real world itself. Phenomenology, therefore, seeks to observe, describe, identify, and illustrate the meanings that

individuals assign to their actions (Zexian and Xuhui, 2010). Understanding the meanings people attribute to soft problems that stem from their worldviews and values transforms many aspects of these problems into a logical and cultural phenomenon. Transforming such issues into a phenomenon will make it possible for individuals to depart from them and expand their field of view. Logical phenomena generate a better understanding of the mental and logical dimensions of people's thinking about the problem.

Similarly, cultural phenomena improve understanding the individuals' inter-subjective interactions in the problem situation. In addition to making the discussion about the definition and problem-solving of the soft problem more structured, it also contributes to people's better understanding of how they contemplate and perceive these issues. It also leads to a better understanding of the logical aspect of the systems ideas, which are created mentally and actionable in the form of social inter-subjective action while interacting with objectivity. Such understanding requires the participation of interest groups and stakeholders in problem-solving.

Stakeholders do not possess the same power level, so understanding cultural phenomena requires the identification of power structures. Stowell and Welch (2012) consider power to be one of the main components of the cultural context of an organization because any change in the problem situation should be studied from the perspective of the power holders in the situation so that their control over the status quo cannot be compromised.

Stowell (1989) uses the metaphor of "commodity" to refer to power in social groups because power is valued by members of the groups and renders the problem situation from one that is not desirable to one that is favorable to them. In his view, awareness of power in social groups cultivates awareness of control strategies used and managed in groups. In addition to raising awareness of informal power, awareness of power in social situations increases a proper understanding of how people exercise power to influence others (Flood and Romm, 2018; Stowell and Welch, 2012). That is why another crucial dimension in understanding cultural phenomena is related to the power structures, as this structure orients people toward self-interest-seeking actions, which people take to achieve their own interests and prevent them from taking other actions that are not to their benefit (Checkland, 1999). It increases the complexity of the problem situation itself. Collective understanding of the ideal models of interest groups with different worldviews (logical phenomenon), along with the understanding of social and cultural aspects (cultural phenomenon), provides a space for creating a social experience by constructing the ideal speech situation (Habermas, 1970). The ideal speech situation is where different groups with different worldviews can freely interact and challenge

each other's views. Such challenges result in structuring the definition and soft problem-solving in a collaborative atmosphere. The formation of the ideal speech situation develops a solution on which accommodation is reached among different worldviews over its implementation through a comparison between the problem situation (observation) with the ideal models (theories). Therefore, the soft problem is uncovered and created in both research and action. It is aligned with the idea of Flood's (2010) view. He believes combining systems thinking with action research in solving soft problems is necessary. Here, systems thinking refers to the awareness of the unknown, and action research holds a meaningful relationship with the unknown.

Recreation of the soft problem occurs through reflection because the definition of change actions for problem-solving is built on considering different groups with different ideal models. Therefore, reflection on the problem situation causes the relationship rationally impaired by the system (due to different worldviews) to be reestablished rationally. Such awareness based on reasoning, mutual understanding, and communication affects both logical presuppositions and the intellectual factions' values, norms, and standards. Therefore, in this approach, instead of instrumental thinking that arises from instrumental actions (Checkland, 1984; Jackson, 1990), some form of communicative rationality (Huaxia, 2010) grows out of communicative actions (Habermas et al., 1985), which promotes the development of unforced agreements (Habermas, 1970) to solve soft problems and improve their situation.

The collaborative nature of problem-solving leads to a solution that rests on the common discourse derived from shared thought and communication, not a language that mindsets have spoken with or conversed with others (Christis, 2005). Therefore, through argumentation, a system of common words is generated, and the relationship between dissimilar social groups with diverse ideal models is reconstructed through communication and understanding. Argumentation brings about the reproduction of new values and assumptions that incites the emergence of new standards in social groups. Therefore, problem-solving leads to a new reality in which different groups can accommodate and live with different worldviews. In what follows, we will consider how the help researchers mentioned earlier solve soft problems.

3.2. The soft problem solution

Using the Soft Systems Methodology (SSM) as one of the most successful problem-solving methodologies in dealing with messy situations has attracted the attention of many researchers and practitioners worldwide. SSM was developed using action research (Checkland and

Holwell, 1998). Therefore, it is premised on a researcher who intervenes in a problem situation, intends to think about the problem in line with the SSM guidelines, and seeks to improve it using a series of courses of action. In this case, the researcher or researchers are striving to ascertain a way of declaring the worldview of the interest groups in the problem situation.

Using analyses 1, 2, and 3, researchers are trying to understand better the political and social contexts of the problem situation. Then, they utilize the models as intellectual devices to raise questions about the problem situation and adopt both logically desirable and culturally feasible actions. Therefore, it can be argued that solving soft problems requires an inquiry into the problem situation, the declaration of systems ideas and their worldviews, awareness of the logical and cultural phenomena, the creation of debate and discussion, and finally, the improvement of the perceived problem situation. Therefore, soft problem-solving can be shown in Figure 3
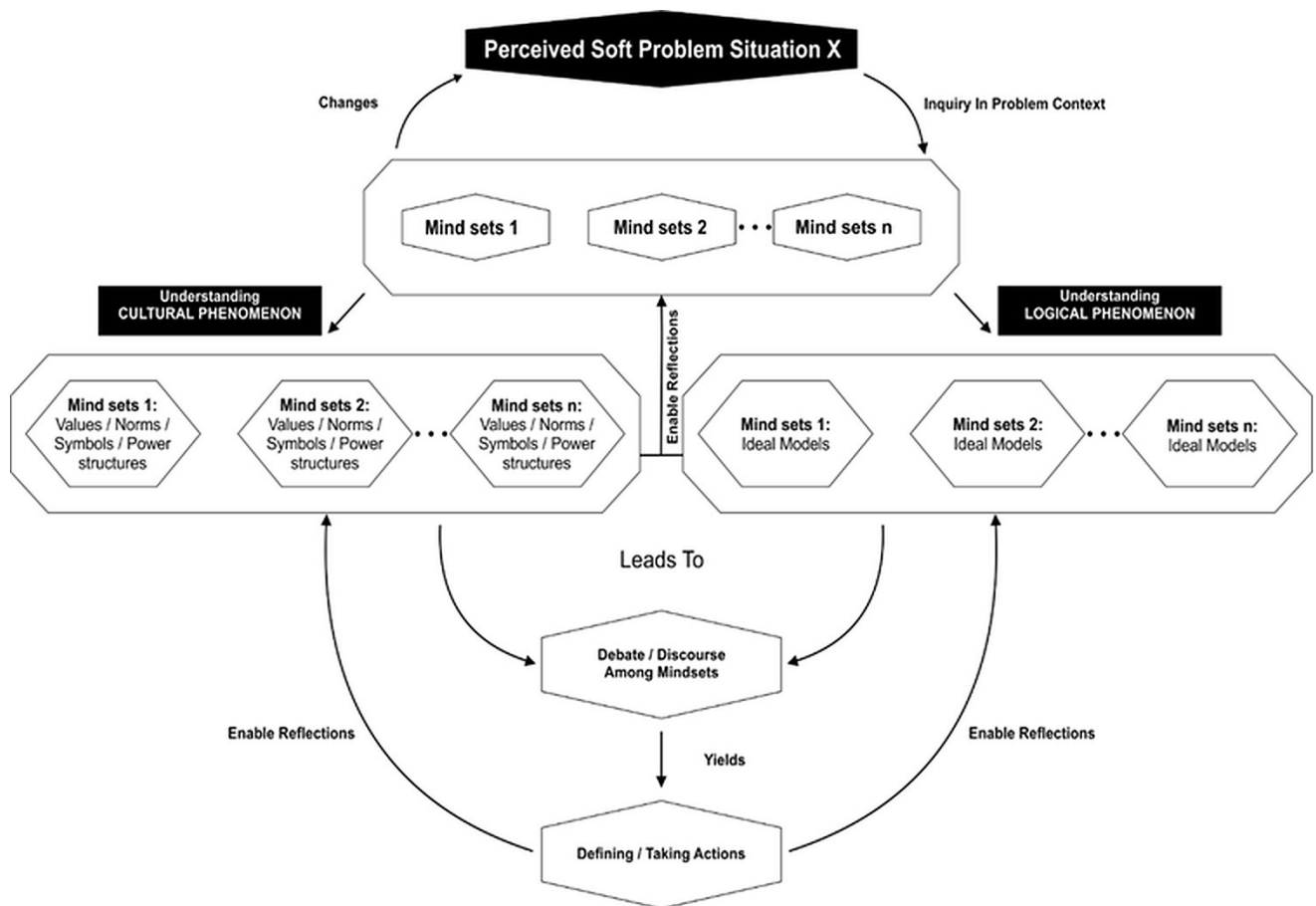

Figure 3. The process of the soft problem solution

Based on Figure 3, the inquiry into the problem situation familiarizes the researcher with all mindsets. Such an intervention will allow all mindsets to participate in problem-solving as frequently as possible. Moreover, a better understanding of the thought factions requires a better understanding of norms, power disposition, and values effectively in the appreciative process of different interest groups. Therefore, it is essential to examine the subjective dimensions effective in interpreting the problem situation through logical phenomena and norms, values , and power structure in the form of cultural phenomena. Awareness of logical phenomena is cultivated by constructing ideal models (Hanafizadeh et al., 2021). According to Wilson (2001), the ideal model in soft systems thinking should be an activity system comprised of concepts and verbs and logical connectivities among them. Therefore, to objectify the ideal models of each mindset, it is necessary to create activity systems.

On the other hand, another subsequent feature of such a system must be the purposefulness of each mindset (Hanafizadeh and Mehrabioun, 2019; Hanafizadeh and Mehrabioun, 2020). Awareness of cultural phenomena is also realized by identifying roles, values , and norms in the problem. On the other hand, according to Hatch and Cunliffe (2013), awareness of the symbols can also afford a better understanding of cultural phenomena. Therefore, in addition to identifying values and norms, it is better to appropriately understand the symbols in the context of the problem situation. Similarly, it is essential to examine issues such as power structures in the inquiry of the problem situation (Champion and Stowell, 2001) because in organizations with asymmetric power structures, powerful and dominant groups can exercise influence on discussions and debates and drive the outcomes of these meetings toward their individual goals. Awareness of logical and cultural phenomena paves the way for the researcher(s) to theorize. Now the space is provided to raise the stakeholders' and interest groups' awareness and understanding of the problem. Stakeholders' participation in solving the problem and their awareness of the ideal models of other thought factions and their thinking allows space for discussion about the problem solution and, in the case of SSM, form a human activity system (HAS) (Hanafizadeh et al., 2021).

Structured discussions seek to compare theories (the results deriving from identifying logical phenomena and cultural phenomena) with observations (the objectivity of the problem situation). In addition to challenging institutionalized assumptions in the view of stakeholders about the problem situation, such debates mould actions that not only improve the problem situation but also promote all stakeholders' understanding and awareness of the problem situation. Such a solution is a purposeful system that rests on concepts and verbs that all

stakeholders acknowledge. In such a system, at first, the ideal models of each interest group have become a purposeful activity model which rests on verbs used to describe systems ideas. Then, through discussion and debate among stakeholders, an accommodation has been made on common concepts and verbs. Therefore, change and problem-solving actions are created based on a system of common concepts and verbs. Such a system also promotes the commitment of stakeholders to problem-solving since it is intended to address the problem situation and improve it. On the other hand, the awareness of each interest group's logical and cultural phenomena of the problem situation encourages their reflection on the problem situation, generating a shared social experience.

4. The quality of solutions

As was earlier stated concerning hard problems, the structure of the solution is influenced by the structure of the problem. The impact of the structure of the solution on the structure of the problem makes it possible for the knowledge derived from the solution of hard problems to attain a replicative nature and acquire applicative actions (Edmonstone, 2014). The replicative aspect of knowledge enables us to use repetitive and routine activities in problems with the same structure (Edmonstone, 2017). In this case, the use of intuition is minimized. In the applicative actions aspect, the individual seeks to extend the learning derived from the problem solution in the form of prescriptive approaches to situations and conditions with the same structure. Such an issue transforms the knowledge needed to solve hard problems into programmed knowledge (Revans, 2016). Therefore, existing knowledge bases for solving hard problems are constantly evolving. That is why solving hard problems involves individuals who are conscious of these knowledge bases and qualified enough to reduce hard problems to sub-problems, solve sub-problems, and synthesize sub-problems into a final solution. Such people should have an appropriate command of technical knowledge in the puzzle situation.

Therefore, it can be claimed that the problem solver's qualifications and awareness of the problem structure, along with the mastery of technical knowledge (Edmonstone, 2014), ensures taming the hard problems and their solving. In this set of problems, knowledge accumulated by the solution is the type of knowledge independent of the person and can be confirmed and evaluated by others. On the other hand, the impact of the structure of the solution on the structure of the problem allows us to establish a direct and causal relationship between the input and the output.

In soft problems, problem-solving requires structuring the problem by creating an ideal

speech situation. A proper understanding of the perceptions of all interested groups is needed to create an ideal dialogue climate. Such an approach is shown in Figure 3. Such a solution will allow space for the stakeholders' participation and a collective solution. Therefore, it is feasible to use their views in solving the problem. Different stakeholders intervene in the problem situation and seek to take action to improve the problem situation regarding collective learning. In this state, the solution is a human activity system, a system of concepts and verbs that all the interested groups accept. During its implementation, there is accommodation among all the interested groups (Hanafizadeh et al., 2021). Therefore, in this state, the solution is not a definitive solution, but there is a distinct procedure consisting of concepts because logical and cultural phenomena have been simultaneously considered in creating this solution. Therefore, in addition to the logical dimensions, the cultural and inter-subjective dimensions are also involved in its formation. In this state, the solution is a shared meaning system. Consequently, like the problem, the solution is a reality that is collectively enacted.

5. Discussion

This research attempts to investigate the nature of the problems. Therefore, the nature of problems and their various aspects, including the formulation of the problem, the approach to confronting the problem, the problem-solving process, and the type of problem-solving for each of the two extreme points of problems (hard problems and soft problems), have been investigated.

Hard problems are problems for there is a general agreement on the formulation and the process of solving among interest groups. Hence, in this set of problems, the ends and the means are transparent. There is also an appropriate cognitive capacity to analyze problems. The main goal of this set of problems is to find the best solution (Tarter and Hoy, 1998). In hard problems, the structure of the problem creates a solution structure. Therefore, the problem-solving approach is based on the reductionism approach derived from breaking down the problem into small sub-problems and independently solving each sub-problems. The type of solution in the puzzle is definitive and optimal, and the problem-solving is carried out by providing an obligative and prescriptive solution. Creating obligative rational solutions can be appropriate for engineering, natural, and medical sciences. What is expected in these sciences is their confrontation with non-social problems. These problems can be complicated but are less complex because, in this set of problems, there are not any different historical experiences (Vickers, 1965), any diverse interpretations of the same phenomenon (Flood, 1998), and any

pursuit of satisfactory approaches (Simon, 1973) in solving the problem. Therefore, the solution structure is similar to the problem structure.

Soft problems are the opposite of hard problems. Unlike hard problems, these problems cannot be tamed, and due to the ill-structuredness of the problem, it is difficult to assign a structure to the solution. The ill-structuredness of this set of problems arises from the fact that there is no identical interpretation of the problem definition and its solutions among the stakeholders. Therefore, the problem solver needs to simultaneously define the problem and create solutions because soft problems deal with social situations, in which each situation is formulated differently and uniquely by the decision maker (Pidd, 2003). The soft problem is a social construct that has been transformed into an unstructured problem by different perceptions of its stakeholders and their different interpretations of the problem situation on the one hand and the language slippage of individuals from an identical situation. According to Checkland and Poulter (2010), the data are the meanings that individuals attribute to data of a social context. Different judgments are made due to different appreciations of people from the same situation. Such an issue reduces the likelihood of a common interpretation of data in the problem situation. Therefore, the lack of information in such situations adds to the complexity of these problems. According to Simon (1976), the lack of information and ambiguity is the most crucial factor in the ill-structuredness of this set of problems. This study considers the approach that grapples with these problems through a holistic approach. According to Checkland and Casar (1986) and Vickers (1965) views, individuals' perceptions are influenced by their historical experiences, values, and assumptions. Thus, soft problems are concerned with different meanings assigned by the stakeholders. In order to formulate and solve soft problems, it is essential to identify the standards, values, and norms on which individuals base their judgments. The identification of standards depends on the awareness of the ideal models of the mindsets; likewise, understanding values requires analyzing the political, social and cultural contexts in the problem situation.

Such an issue renders the type of people's view of soft problems and the context in which the problem occurs into logical and cultural phenomena. Therefore, the problem solvers can take neutral positions, distance themselves from them, and expand their field of view. In this way, an opportunity is provided for debate and discussion among different perspectives, and a space is developed for translating a messy situation into an ideal speech situation (Habermas, 1970).

Creating such a situation prepares a space for provoking thought and problem-solving. Such

an issue brings about 6 achievements in solving soft problems.

1) In soft problems, due to the lack of structure in the solution, there is ambiguity in defining the problem and its solution. Dialogue between different groups reduces ambiguity in defining and solving the problem. 2) In soft problems, individuals hold different standards, values, and norms; consequently, creating an ideal speech situation raises the awareness of different groups of standards, values, and norms of other groups and enables them to call them into question. 3) By challenging assumptions, values, and norms, thought is replaced by reflection because people do not just think about the status quo, but their past experiences and perceptions of issues are criticized during an argumentation; additionally, they are motivated to reflect on their way of thinking. Such reflective learning leads to a rational reconstruction of communication that the system has rationally broken down. 4) The ideal speech situation creates a shared social experience. This shared social experience orients problem-solving toward benefiting from communicative rather than instrumental action and prevents forced agreements in the problem situation. 5) Such communicative actions transform the solution into a system of common concepts and verbs with a shared agreement on their meanings. The solution is based on the language of the people's thoughts, not a language that they have spoken with or conversed with others. (6) As ideal models are created based on concepts stemming from the individuals' purposefulness to improve the state, solutions are not definitive answers but distinct procedures consisting of concepts and verbs that inform the problem's solution. Moreover, since the study of cultural dimensions and inter-subjective have been involved in the formation of the procedure, it is a system of shared meanings. Thus, the solution is a social reality like the problem that is collectively enacted.

Regarding the current research findings, in dealing with soft problems, understanding the perceptions of all thought factions is required to create an ideal speech situation. Such an approach is shown in Figure 3. Such an issue will allow space for the participation of all stakeholders and a collective solution. Such a solution is a system of concepts and verbs acknowledged by all the thought factions, and there is an accommodation and inter-subjectivity over its implementation among all mindsets.

Considering those mentioned above, it is possible to illustrate the differences between hard and soft problems in the formulation and problem-solving phases in Tables 1 and 2.

Table 1. The differences between hard and soft problems in the formulation phase

Types of problems	Hard problems (structured-tamed)	Soft problems (messy, ill-structured)
Agreement on the definition of the problem	Yes	No
The domain of the definition of the problem	Clear	Unclear
The source of uncertainty	Limitations of technology and measurement devices	Irrational behavior of individuals involved in the problem situation
Type of data	Clear	Deficient
Nature of data	Independent of the context	Influenced by the context
The root cause of the problem	Known or can be explored through a causal relationship	Unknown and the unlikely and far-fetched relationship between cause and effect
Structure of the problem	Precise and predictable in time intervals	Unclear and unpredictable in time intervals
Problem situation	Repetitive and replicative	New and unique
Dimensions of the problem	Complementary	Contradictory
Success in the problem	Identical interpretations	Diverse interpretations
Indices of the definition of the problem	Objective and free from subjective judgment	Subjective and intertwined with personal judgment
New problems	In line with completing the old problems	Generated by old problems

Table 2. Differences between hard and soft problems in the problem-solving phase

Type of problems	Hard problems (structured-tamed)	Soft problems (messy, ill-structured)
Approach to problem-solving	Reductionism (mechanistic)	Holistic (organic)
Problem-solving process	Agreement	Lack of agreement
The objective of the problem-solving	Complementing the previous assumptions	Challenging the previous assumptions
Structure of the problem-solving	Influenced by the structure of the problem	Influenced by the mental structure, basic assumptions, and framework of ideas
Nature of the problem-solving	Rational activity	Social action
The audience of the problem-solving	General and with identical interpretations	Interested groups with similar interpretations within similar groups and contradictory interpretations outside groups
Type of solution	Definitive/optimal/obligative/normative	Procedural/ instructions based on human activity system/Meaningful procedure of concepts and the relationships among them
Modeling of the problem-solving	Real models	Ideal models (representing the way individuals think about the real world)
Philosophical assumptions used in the problem-solving	Positivistic assumptions	Phenomenological assumptions
The criterion for reaching the solution	Definitive/influenced by assumptions	Judgmental/ influenced by values, norms, and standards
The criterion for evaluating the solution	Objective	Subjective/ Judgmental
Quality of the solution	Right/wrong	Satisfactory and relative (Better or worse, appropriate or inappropriate, adequately good or bad)
The pattern of the solution	Linear	Fluid, fuzzy, and non-linear
Generalization of the solution	Independent of the situation and generalizable to similar situations	Dependent on the situation and not generalizable to similar situations
Action of problem-solving	Instrumental	Communicational
The knowledge accumulated by problem-solving	Repetitive and applicative	Interpretive and associative/practical
Resistance to changes in problem-solving	Low	High
How to reach the solution	Empirical and rational experience	Shared social experience
The outcome of the solution	Clear (through causal relationship)	Unclear
The role of the problem solver	Taming and managing	Leadership, challenging the assumptions and changing idea frameworks

According to Table 1, the differences between soft and hard problems in the definition phase of the problem derives from their dependence or independence on a situation. In hard problems, since the problem is independent of the situation, it is not influenced by the problematical situation. It also reduces uncertainty in the problem. Reduction in uncertainty in the problem enables the researcher to unravel causal relationships and predict the future of the problem.

In contrast, due to their dependence on the problem situation and the social processes, soft problems are liable to be influenced by numerous interpretations and judgments. Additionally, soft problems grow out of old problems and are susceptible to previous perceptions of individuals. That is why they are intertwined with mental indices and judgments. Therefore, the possibility of predicting and decisively resolving the problem is significantly reduced. That is why the uncertainty in the problem is elevated, and the researcher encounters contradictory rather than complementary components.

According to Table 2, diverse approaches are adopted to solve hard and soft problems. Hard problems require linear, reductionist, and rational methods. Since there are identical interpretations of the problem-solving methods, the criteria for evaluating the response to hard problems are also definitive. The purpose of solving the problem is to complement the previous assumptions. In hard problems, the criteria for evaluating the solution are objective and entirely transparent, and the accumulated solutions can be generalized to similar situations. Therefore, the outcome of the solution is specific, and the derived knowledge is repetitive and applicative. In soft problems, the nature of problem-solving is considered a social activity rather than a rational activity because problem-solving encounters different groups that have identical interpretations of the problem within their own group, but their inter-group interpretations are diverse. Therefore, the criterion for achieving a solution is judgmental and influenced by the appreciation of individuals; therefore, reaching a solution requires the participation of different groups and creating a shared social experience. Such a process also requires that the problem solver hold leadership skills and be capable of challenging the mental assumptions of individuals. Therefore, the solution structure of the problem is influenced by the mental structure of individuals; hence the quality of the solution is not definitive and leads to satisfactory patterns. In soft problems, problem-solving is not based on standards imposed but on a learning system. Therefore, it can be argued that in contrast to hard problems, a definitive solution is not an optimal answer in solving soft problems, but rather a shared meaning system is preferred in order to create a learning system. Therefore, a solution is chosen, built on attributing meaning to ideal models of individuals in the problem situation and a better

understanding of their related activities by identifying the problem's cultural and social dimensions of the problem.

6. Conclusion

Problems can be plotted across a continuum with two extremes of hard to soft. Problem-solving involves defining the problem, selecting an approach to the problem, and configuring the research process. The scholar's philosophical assumptions influence the correct way to follow such a process. That is why prior to the implementation of the above steps, the philosophical assumptions of the researcher need to be adequately explained. The research results reveal that there is still incommensurability between the methodology and the nature of the problem (Flood, 1989; Hanafizadeh and Mehrabioun, 2017). Therefore, researchers' use of methodology, methods, and techniques is not consistent with the nature of the problem. Researchers mostly focus on the mechanical use of techniques and methods instead of understanding the nature of the problems. This research strongly states that before dealing with a problem solution, it is essential to recognize the nature of the problem. Thinking about the nature of the problem serves as a precondition for thinking about the problem. It leads to the fact that instead of mechanically undergoing a sequence of steps of methodology, the researcher's approach to problem solution must be an attempt to identify the problem's nature better and better adapt the methodology to the problem. It makes researchers encounter the soft problem on a problem oriented rather than a user-oriented basis.

For this reason, this research aims to help researchers strike the right balance between the nature of the problem, the problem-solving method, and the applied methodology. To achieve this purpose, the difference between the nature of soft and hard problems was considered in the first question. The results of this study indicate that the structure leads to the difference between the nature of soft and hard problems. In hard problems, the structure is distinct and varies with a predictable trend in time; soft problems do not follow a specific, transparent, and predictable structure. The existence of a structure in hard problems makes the definition of the problem and the definition of solutions capture the identical readings and interpretations of the various stakeholders. In this way, uncertainty in problem-solving is minimized. The problem solvers' confidence in the structure of the problem transforms the researchers' concern into an accurate explanation of the results of problem-solving, the inclusive assurance of the accuracy of the accumulated information, and the choice of a solution with the most excellent convergence with the problem structure. Therefore, the researcher's concern in this set of problems is identifying,

prioritizing, evaluating options, and choosing the best problem-solving instructions. In this state, the problem-solving approach for hard problems, as shown in Figure 1, involves going through three stages: 1) understanding the structure and assigning structure to the sub-problems during the process of decomposing the main problem into sub-problems; 2) assigning the best solution to any of the sub-problems to solve them or develop a solution instruction for a sub-problem; and 3) how to synthesize, interconnect, link, and integrate the solutions of sub-problems to formulate the answer to the main problem.

In soft problems, the structure of the problem is uncertain and unpredictable because the fluid context of the problem influences it. Therefore, uncertainty increases in problem-solving. In this set of problems, the researchers' efforts should be focused on understanding the problem's context instead of knowing the structure of the problem. The results of this study also indicate that to understand the context of the problem, the researcher's approach to the configuration of the research should be oriented from the positivist and rational approaches needed in hard questions toward phenomenological approaches. Such an understanding should be built on identifying logical and cultural phenomena in the context of the problem. An understanding that focuses on stakeholders' participation in the problem situation. The logical phenomena are identified by constructing the ideal models of the interest groups in the problem situation.

Understanding cultural phenomena occurs through understanding standards, values, norms, power structures, and symbolic phenomena in the problem situation. The collective understanding of the ideal models of interest groups (logical phenomena) and the understanding of social, political, and cultural aspects (cultural phenomena) lay the groundwork for forming a shared social experience through constructing an ideal speech situation. Such a situation will lead to structuring the definition and solving soft problems. Now the soft problem has acquired a better structure because discussions and debates have inspired different groups to reflect on the rational and cultural phenomena of the problem situation and inspired the same readings and interpretations of the problem context.

The second question addresses the difference in the quality of solutions for hard and soft problems. The results of this study demonstrate that since the problem-solvers of hard problems are aware of the structure of the problem, their attempt to solve the problem is focused on identifying the causal relationships in the problem rather than assigning structure to the problem. In this case, owing to the same problem interpretation, the knowledge derived from the solution is independent of the person and can be confirmed and evaluated by others. Therefore, the answer is a normative, definitive solution obtained by taming the problem the

researcher.

In soft problems, there is no structure in the problem, so the researcher's concern is to create such a structure. In such problems, instead of identifying causal relationships in the problem situation, the researcher attempts to analyze the situation of the problem through rational and cultural recognition of the actor's actions in the problem situation. Unlike the solution to hard problems, the solution is not a definitive answer but a distinct procedure consisting of concepts and verbs that seek to conceptualize the purposeful actions of multiple stakeholders because logical and cultural phenomena have been simultaneously considered in creating this solution. Therefore, in addition to the subjectivity dimensions, the cultural and inter-subjective dimensions are also involved in its formation. In this case, the solution is a shared meaning system. Consequently, like the problem, the solution is a reality that is collectively enacted.

For this reason, the quality of the solution draws on its capability of constructing a situation where understanding the purposefulness of the actors and stakeholders of the problem situation serves as the basis of the problem. In this case, the quality of the solution is defined based on the explanation and understanding purposefulness of the interest groups and the representation of human actions and cultural phenomena of the problem situation. The more appropriately the solution can describe the problem situation, including the purposefulness of the interest groups (ideal models), social relations, social norms, power structures, and symbolic phenomena in the problem situation, the higher quality it can achieve. So, the quality of the solution derives from its capability of conceptualizing purposeful actions along with the values and norms affecting social action.

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