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Are project managers ready for the 21th challenges? A review of problem structuring methods for decision support

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Abstract:

Numerous contemporary problems that project managers face can be considered as unstructured decision problems, characterized by multiple actors and perspectives, incommensurable and/or conflicting objectives, and important intangibles. This work environment demands that project managers to possess not only hard skills but also soft skills with the ability to take a management perspective and, above all, develop real leadership capabilities. In this paper, is presented a family of problem structured methods for decision support, aimed at assisting project managers in tackling complex problems. Problem structured methods are a family of soft operations research methods for decision support that assist groups of diverse composition to agree on a problem focus and make commitments to consequential action. Project management programs are challenged to implement these methodologies in such a way that it is organized around the key competences that a project manager needs in order to be more effective, work efficiently as members of interdisciplinary teams and successfully execute even a small project.

Keywords:

project management; problem structuring methods; hard methods; soft methods.

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1. Introduction

Nowadays project managers are asked to do more than just apply scientific knowledge to solve practical problems. Today's competitive global market and changing work environment demand that project managers possess not only hard skills but also soft skills and leadership which give them an advantage in the workplace. Whereas a leader can be the person who has the ability to inspire and motivate other to do what he or she wants them to do with a feeling they enjoy doing it, a manager can be the person who works effectively with others to accomplish set goals [1], [2]. For example, in the field of civil engineering, Acciszenwski [3] considered the lack of leadership as a crisis and urged civil engineers to use the present challenges to change the profession to meet the new demands.

Professional practice can be defined as the act of working fist hand by using a combination of highly specialized knowledge and skills that are obtained through study, training, and experience [4]. Future project managers must not only have this technical knowledge, but also be better prepared in communication, with the ability to take a management perspective and develop real leadership capabilities [1], [5]. It is time to change the way we approach project management programs. Project management courses should change accordingly by re-designing it in such a way that it is organized around the key competences that a project manager needs in order to be more effective and work efficiently as members of interdisciplinary teams [6]. In this context, we need pedagogies and approaches that help project managers develop soft skills and sufficient confidence along with required technical competence to independently planning, managing, and successfully execute even a small project [1].

This paper begins showing the evolution from the hard to the soft paradigm in Management Science. Next, are presented problem structured methods, a family of soft operations research methods for decision support aimed at assisting project managers in tackling complex problems. Finally, there is a concluding section with the main findings of the paper.

2. Hard methods versus Soft methods

Within Management Science, it is usual to distinguish between hard and soft paradigms [7], [10]. The terms hard and soft constitute two broad tendencies for thought which have had a strong influence on the development of a variety of practical and academic disciplines. Each of these terms refers to two distinct paradigms involving particular values, ways of viewing the world and approaches to practice [11]. Hard methods are rooted in positivist and realist philosophies, emphasizing the search for objective knowledge, while the soft approaches stem from interpretivist and constructive schools of thought, emphasizing the inter-subjective creation of knowledge [12]. Soft issues include community perception, safety, environmental impacts, legal acceptability, political and social impacts, benefits, stakeholders, value management, and communication [13], [14].

The differences between the hard and soft approaches have varying implications at the level of theory and practice. These differences, which include general classification schemes, differences based on project output tangibility and the degree of definition of project goals and objectives can influence project success [13], [15]-[18]. Wateridge [19] considered that projects have often been perceived to have failed due to project managers not paying due attention to soft criteria. Yeo [20] remarked that product acceptance goes beyond technical quality, extending into soft criteria, while Williams [21] showed the value of soft ideas in project models.

The willingness to optimize operations locates the emergence of what Checkland [22] termed "hard" systems thinking in the late 1950s-1960s. It has been associated with the so-called classical operations research and the belief that organizations can be seen as objective worlds. These approaches relied on the assumption that the decision maker acts in full possession of rationality or bounded rationality and the ability to choose between alternatives generated in full knowledge of what the problem is and when she/he wants to be [23]. The hard paradigm is commonly associated with deductive reasoning and quantitative or reductionist techniques, attributes which are often associated with rigour and objectivity. It has also been referred to as the rationalistic, positivistic, scientific, reductionist [24] or quantitative

paradigm [25]. Practice based on the hard paradigm tends to emphasize efficient, expert-led delivery, control against predetermined goals and an interest in underlying structure [11]. Examples of hard methods include Systems Engineering [26], [27], Systems Analysis [28] and early Systems Dynamics [29]. The hard paradigm promotes an understanding of the world as an objective reality, to which all people have equal and unvarying access. Systems are mechanistic processes, with stable, or predictable varying, relationships between the relevant variables [30]. Systems are interpreted through functional analysis, the attempt to understand a system in terms of its purpose [31].

During the 1960s and 1970s, a number of Soft Systems Thinking methodologies emerged in the UK, amongst the most influential were Checkland's soft systems methodology [32], [33] and cognitive mapping [34]. Ackoff [35] called this paradigm the "design approach" because these methods attempts to dissolve systems of problems or messes as opposed to the "research approach" that aims to tackle the context where the mess takes place. This paradigm, usually taken as the one representing soft operations research, is probably the most well-known and populated in terms of the number of methodologies adhering to it, methodologies such as: soft systems methodology; interactive planning, strategic assumption surfacing and testing, systems intervention strategy, strategic choice approach, social system design, cognitive mapping, etc. The soft paradigm is commonly associated with an interpretative epistemology, inductive reasoning, and exploratory, qualitative techniques, which emphasize contextual relevance rather than objectivity. Practice based on the soft paradigm emphasize learning, participation, the facilitated exploration of projects, and typically demonstrates an interest in underlying social process [11].

Hard and soft issues require different management approaches and skill sets which need not be mutually exclusive and can be applied in a complementary way [36]. Table 1 shows the differences between the hard and soft paradigm regarding management activity, methodological orientation, research intention and methodologies associated. Table 2 shows the seven dimensions, identified by Crawford and Pollack [18] as encapsulating the key issues in the analysis of hard and soft aspects of projects, namely, goal clarity, goal tangibility, success measures, project permeability, number of solution options, degree of participation, and stakeholder expectations.

Table 1. Differences between the Hard and Soft paradigm

Problem Structuring Methods	Hard paradigm	Soft paradigm
Management activity	Rational process of decision making. Decision-makers act in full possession of bounded rationality	Effort to maintain relations through metaphors and evaluating different courses of action
Methodological orientation	Oriented to seek (discover) law relations amongst variables, 'deep' structures and patterns	Learn from the intervention and understand perception and people purposes
Research intentions	Optimization, problem solving	Look for consensus or accommodation between stakeholders' interest
Methodologies associated	Linear programming, simulation, PERT-network analysis, forecasting, decision trees, queuing theory, Markov analysis, integer programming	Soft systems methodology, interactive programming, strategic assumption surfacing and testing, systems intervention strategy, Strategic choice approach, Social system design, cognitive mapping, SODA, Problem structuring methods

Table 2. Dimensions encapsulating the key issues in the analysis of Hard and Soft aspects of projects

	Hard methods	Soft methods
Goal clarity	Well-defined technical problems where goals and constraints are previously defined with emphasis on the delivery of a solution to a predetermined problem	Fuzzy, ill-defined project situations involving human beings and cultural considerations, focusing on learning, exploration and problem definition
Goal tangibility	Engineering and/or construction projects where tangible goals can be defined in clear measurable terms	Organizational change projects with intangible goals having to rely on subjective interpretation and judgment
Success measures	Quantitative measures (EVM, PERT, etc.)	Qualitative measures (morale, meaning, attitude, etc.)
Project permeability	Projects of short-, or medium- term duration in stable environments and well developed fields	Research projects, organizational change projects, bureaucratic projects, or projects where the determination of a clear boundary between what will and will not affect the project is more problematic
Number of solution options	Solutions, which are culturally desirable and technically feasible, are handed down without room for discussion, focusing on the optimization of predetermined solutions, without undue examination of its intrinsic value or alternatives	Learning, debate, participation, exploration and questioning of alternative options and innovative solutions about the situation. Solution are culturally feasible and technically desirable
Degree or participation	Team members are seen as experts in their individual fields with clearly defined roles, where everyone clearly understands the boundaries between the tasks that they and others have to complete	Participative, collaborative, facilitative approach where multiple perspectives and views are sought on many issues and people are encouraged to cross professional boundaries
Stakeholder expectations	Minor degree of interactions between stakeholders. People are seen as interchangeable, are assumed to act in predictable ways with their actions being determined by the environment. The organization can be viewed as a machine that can be engineered	Greater degree of interaction between stakeholders. The emphasis is on the people who will take the action to improve the situation. People are understood to be part of complex cultures with individual expectations, desires, values, rules and norms of action

Source: Crawford and Pollack [18].

Understanding and modeling interactions between individuals, groups or organizations should inevitably be a major concern for project managers. While sophisticated tools and techniques have been devised to represent and understand the interactions which take place in designed mechanical systems, other multi-actor situations whose evolution is dependent upon the whims, prejudices, beliefs, interests and power to act of a rabble of disparate characters have been some neglected by modelers [37].

Existing methods of teaching and learning favour individuals whose cognitive styles are analytical. Intuitive styles of thinking tend to take a broad perspective on a problem before reaching a conclusion whereas analytic styles of thinking tend to take a more logical, step-by-step approach before deciding. In a work context, an intuitive project manager prefers rapid, open-ended approaches to decision-making, relying on random methods of exploration and work best on problems favouring a holistic or "big picture" approach. On the other side, analytic project managers work best on problems favouring a detailed rather than a holistic approach and prefer a structured approach to decision-making, applying systematic methods of investigation [6]. Some authors have linked the intuitive and analytic cognitive styles to the right-left cerebral hemisphere. According to Mintzberg [38], the left cerebral hemisphere is believed to be specialized for primarily analytical, rational, and sequential information processing, whereas the right hemisphere is believed to be specialized for primarily intuitive, holistic and simultaneous information processing. Thus, important

policy and strategy level processes required to manage an organization rely to a considerable extent on the faculties identified with the brain's right hemisphere such as hunch, synthesis and intuition, whereas at the middle operational levels the analytical community is more suited [6],[38]. Teaching and learning methods should, at least, ensure that equal amounts of analysis and intuition are assessed during the learning process [6].

Traditionally, courses have been taught in a straightforward way, starting with a lot of definitions, basic concepts and methods for solving well defined problems, which in most cases are simplified and idealized [39]. Whereas this approach is necessary to teach students basic principles and formulas needed to make judgments, this way of teaching may not be sufficient to produce leader project managers [40]. Traditional classes prepare undergraduate and graduate students to master their technical skills in a specific engineering field without much time allotted for leadership practice and with little emphasis on the management discipline [1]. Project Management programs are challenged to come up with innovative ways to teach classes so that graduates are prepared to take over the challenges facing twenty-first century. Effective project management must cover not only fundamental and complex topics with an excellent aptitude in applying mathematics, physics, and general science, but also incorporate strategy and problem solving, administration, and a myriad of soft skills [5]. Implementation of these methodologies in project management is the most effective way to prepare project managers for the twenty-first century [1].

3. Problem Structuring Methods

Problems are constructs created by the perceptions of those affected by them and defined by different and equally valid worldviews. Numerous contemporary problems related to public policy, organizational strategy and change can be considered as unstructured decision problems [41]. Such problems are characterized by multiple actors, multiple perspectives, incommensurable and/or conflicting interests, and important intangibles [42]. Traditional operational research methods have serious limitations for dealing with this type of problems as generally ignore the typical complexities of unstructured decision problems. In response, a variety of Problem Structured Methods (PSMs) have been developed.

PSMs are a family of soft operations research methods for decision support that assist groups of diverse composition to agree a problem focus and make commitments to consequential action [42], [43]. Their characteristic feature is the use of a model to represent alternative versions of the complex situation of common interest, combined with facilitation to help group members make constructive mutual adjustments [44]. PSMs may be applied for descriptive and normative purposes. Whereas descriptive studies aim at framing a decision problem-explaining the situation, normative studies aim at finding prescriptive solutions to a decision problem. The most common reason stated to apply PSMs is that these methods allow for a way of modeling that has not been done before or deviates from current practice [41]. PSMs aim at helping an actor or a group of actors that is confronted with an unstructured decision problem to come to a shared understanding of the problem situation or help to decide on a joint course of action. According to Mingers and Rosenhead [45], PSMs should be able to account for different perspectives and bring them together, be understandable for the users, be able to accommodate changes in actors' perceptions, and come to partial solutions.

Generally speaking, PSMs can be applied to three types of situations [41]: (i) a deadlock situation that is not progressing any longer and where actors are looking for a way out. The purpose is to get new information that might help the debate or explain why the situation it is; (ii) a conflict situation where the actors are opposed to each other and want to win the fight instead of coming to a shared solution. The purpose is to provide strategic advice to the parties or provide an explanation for the situation; (iii) a situation that can be characterized by actors willing to negotiate. The purpose is to get people to reach some kind of resolution or insight into possible outcomes.

What constitutes a quantitative or qualitative PSMs is a gliding scale. On this scale, game theory can be placed at the quantitative extreme followed by metagames/conflict analysis, hypergames, drama theory, Q-methodology, and transactional analysis. Softer methods like soft systems methodology [46] and strategic option development and analysis [47] can be placed on the qualitative side with anthropological and ethnographic methods at its most extreme

[48]. Examples of well-established PSMs also include *strategic choice approach* (SCA) [49], *group model building* [50] and *decision conferencing* [51].

According to the type of information that is used as input for the PSMs, van der Lei and Thissen [41] distinguish two different modeling approaches: desk research or intervention. With an intervention, the analyst usually facilitates the decision-makers and the decision-makers learn about the decision environment in the form of a workshop. With desk research the information usually comes from publicly available reports sometimes supplemented with interviews. In this case, the analyst primarily learns about the decision environment and then communicates the results of the study. Table 3 shows the benefits obtained from the application of the PSMs presented in the next section.

Table 3. Benefits obtained from the application of PSMs

PSMs	Benefits obtained from the application
Metagames	More insight into possible strategic behavior, finding counter intuitive outcomes, a compromise, and simulation of the course of events
Drama theory	More insight into mutual dependencies of actors, reduction of conflicts and more collaboration among the parties involved
Hypergames	More insight into different perspectives, allow for a logical choice to be made, help to provide hypothesis about people, and model interactions in a helpful way
Q-methodology	Better ability to make informed policy decisions, understanding of different discourses that take place, and help framing a problem
Transactional analysis	More insight into mutual dependencies, control of actors and simulation of real-world events
Soft Systems Methodology	More insights into organizational and cultural issues and information flows within the organization and the way relationships in the company enhance this flow
Strategic Options Development and Analysis	Arrive at a negotiated agreement exploring different options and ramifications through a graphical representation of the situation.
Strategic Choice Approach	It provides a comprehensive and logical framework for evaluating alternatives understanding the relationship between strategy and outcomes.
Cognitive mapping	It provides a way to visualize the relationships between concepts through the use of a network of variables
Group model building	It provides a way to combine the different views of a group of actors ensuring their commitment with the insights generated during the modeling process.
Decision Conferencing	It helps participants to understand their beliefs, judgments and preferences in the context of the decision making problem and the different options facing them.

Source: van der Lei and Thissen [41].

3.1 Quantitative Problem Structuring Methods

3.1.1 Metagames/Conflict Analysis

The objective of Metagames/conflict analysis is to analyze the strategic power of different actors in a decision-making situation. The concept of Metagames, developed by Howard [52], has its roots in game theory. However, whereas in a classic game theory model the outcomes for the players need to be known in advance, in Metagames the outcomes are

constructed from the options of the different actors. These outcomes are all possible combinations of the options minus the infeasible outcomes removed by the analyst [41]. Conflict analysis extends the concept of metagames by adding several solution concepts, which resemble different types of possible behavior (rationality) of the actors involved for solving the game [53].

3.1.2 *Drama Theory*

Drama theory [54] is a PSM based on game theory which adapts the use of games to complex organisational situations, accounting for emotional responses that can provoke irrational reactions and lead the players to redefine the game. The objective of drama theory is to come to a resolution of a problem situation through allowed preference and option changes [55],[56]. Drama theory takes the concept of metagames further, because irrational behavior, that is, preference changes induced by the emotions of actors and option changes are allowed under the pressure of pre-play negotiations [41],[57]. In a drama, emotions trigger rationalizations that create changes in the game, and so change follows change until either all conflicts are resolved or action becomes necessary. The game as redefined is then played [57]. The transformations that the game suffers result from pressures that players place upon each other during pre-play negotiations, as they exchange threats, promises, emotional persuasion and rational argument. The conflict that is studied is presented with vignettes that resemble the lay out of the analysis of options method [58]. That is, the options outcomes and preferences of the actors involved are stated. With these vignettes, the actors start the negotiations. The way to resolution of the problem can be hampered through six different dilemmas an actor can be confronted with. Dilemmas are situations that represent “a tension between the use of the position and fallback adopted and the dictates of rationality (in the sense of choosing in accordance with present preferences)” [59]. A conflict is resolved when all dilemmas for all actors have been overcome.

3.1.3 *Hypergames*

The objective of Hypergames is to show how different perceptions of actors determine the outcome of a problem situation [60],[61]. Hypergames also start from the basic idea of game theory, however, by taking the different perspectives of the actors into account and solving the problem from the perspective of each individual actor. Hypergames allow for the study of the influence of individual perspectives on the outcomes of the problem.

3.1.4 *Q-Methodology*

Q-methodology is a statistical tool whose purpose is to detect shared views and/or preferences in group of actors [62]-[64]. The shared preferences of the actors are found through, first, identifying individual actor's perceptions and preferences by a survey and/or interviews and, second, applying an inverted factor analysis to the gathered individual perceptions. The method has been useful in detecting the alternative frames actors have on policy problems [65].

3.1.5 *Transactional Analysis*

Transactional analysis is based upon Coleman's social theory [66] which takes micro economic thought as a starting point and translates it to social systems. The idea is that actors exchange power and control over issues instead of money for products. The objective of transactional analysis is to calculate what the best collective decision in a problem situation will be. With this aim, transactional analysis calculates the optimal division of control and interest over the issues in a problem situation for all parties. This optimal division of control and interest is a clearing of all excess control that actors have over certain issues. This excess control is traded for more control over issues that interest actors.

3.2 *Qualitative Problem Structuring Methods*

3.2.1 *Soft Systems Methodology*

Soft Systems Methodology (SSM) [33] attempts to foster learning and appreciation of the problem situation between a group of stakeholders rather than set out to solve a pre-defined problem. SSM provides a framework for tackling many real-world situations where there are divergent views about the definition of the problem. Thus, the real problem is defining the problem. There are two main modes within SSM, real world activities and systems thinking about the real

world. Initial work involves interviews and meetings to gain an understanding of the problem situation. Systems thinking uses concepts of hierarchy, communication, control, and emergent properties to identify relevant systems. These relevant systems are logically defined by constructing root definitions which are then used to generate conceptual models of the selected systems. Different conceptual models representing different viewpoints are then used as the basis of a debate, which can lead to feasible and desirable change and then to action.

3.2.2 *Strategic Options Development Analysis*

Strategic Options Development and Analysis (SODA) [47] is a method for working on complex and messy problems with individuality and subjectivity as the basis for problem definition and creativity. SODA uses interview and cognitive mapping to capture individual views of an issue. Group maps constructed through the aggregation of individual cognitive maps are used to facilitate negotiation about value/goal systems, key strategic issues, and option portfolios. Rather than move towards abstraction or simplicity, SODA sees strategic management in terms of changing thinking and action rather than planning [67].

3.2.3 *Strategic Choice Approach*

The Strategic Choice Approach (SCA) is used in face to face workshops of a decision making group as a framework for communication and collaboration between people with different backgrounds and skills [67]. SCA is viewed as an ongoing process in which the planned management of uncertainties which surround the decisions to be addressed play a crucial role. Rather than looking towards an end product of a determined strategy at some future point in time, SCA focuses on decisions to be made in a particular situation, whatever their timescale and whatever their substance. An explicit balance is agreed between decisions to be made now and those to be left open until specified time horizons in the future.

3.2.4 *Cognitive Mapping*

Cognitive mapping helps managers reach a collective judgment about issues that are ambiguous, complex and often of a contested nature [68]. The process of cognitive mapping enables those groups of managers to model the complexity of the problem sharing views and perspectives and exchanging opinions. It is the realization of differences between individuals and the following discussion which proves most useful by giving prominence to distinctions and making connections that might otherwise be overlooked [69].

3.2.5 *Group Model Building*

Group Model Building was initially developed in the 1980s by leaders in the field of systems dynamics who recognized the potential of developing computer models and simulations with participants that leveraged the diagramming conventions of systems dynamics [50],[70],[71]. The design of group model building varies along four dimensions [72]:

- Who is defining the initial issue or problem? Initially, this will often start with someone with training in systems dynamics until community members start to gain experience in group model building.
- Do projects start with some initial model structure or with a blank slate? Unstructured group process generally requires high levels of systems dynamics and group model building training to be successful.
- What type of model is going to be developed? Will the focus of the project be to develop an informal causal map or a formal computer simulation model? Informal causal maps are frequently used at early stage of a modeling process to help conceptualize the system and define the problem, as well as at the end of a project to communicate the results from analyzing a simulation model.
- Do projects start with some initial model structure or with a blank slate? If the project starts with some initial model structure, a concept model to introduce the language of systems dynamics can be used [73]. In the blank slate approach the project starts with some type of exercise that elicits the main issues and variables related to the project.

3.2.6 Decision Conferencing

Decision conferencing process is a way of helping a group of actors to resolve important issues in their organization under the guidance of an impartial facilitator with the aid of a decision analysis model of participants' perspectives on the issues. The facilitator serves as a process consultant, guiding the group through the stages of discussing the issues, developing a model and exploring the results. Exploration generates new insights and stimulates creative thinking, resulting in changes to the model and to intuitions. Rather than providing an optimal solution, the model serves as a tool for thinking [74].

4. Conclusion

Project Managers must not be limited to monitoring and controlling of projects. They must have the skills needed to make sound decisions with the possibility and authority to effectively influence the direction and course of a project. In this paper, is presented a family of quantitative and qualitative soft methods, aimed at assisting project managers in tackling complex problems, as well as the benefits of its application. Traditional operations research methods have serious limitations for dealing with these type of problems that today's competitive global market and changing work environment is increasingly facing. These methods can help project managers to be better prepared in communication, with the ability to take a management perspective and develop the real leadership capabilities and skills that project managers need in order to be more effective, work efficiently as members of interdisciplinary teams and successfully execute even a small project. Project Management programs are challenged to implement these methodologies in project management courses as the effective way to encourage growth and development of young professionals, and to prepare them to take over the challenges facing the twenty-first century. In future research, the application of the methods presented in this paper may contribute to a better understanding of the relationships of the different actors involved in a project and the impacts of the project managers' decisions on project performance.

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