Strategic Decision Making: A Study using Computational Complexity Theory

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Abstract: Strategic Decision-Making (SDM) is the process of charting a path focused on long-term priorities and a vision for an organization. SDM is the fundamental responsibility of Top Management teams (TMT) and is considered as central to an organization's survival and growth. An appropriate ongoing strategic decision making facilitates an organization to align its operations with external dynamic conditions, contributing to retaining their competitive position. Most often decision making is viewed as a rational or bounded rational principle with the assumption of decision makers having the best actions to choose from. This principle does not take into consideration the challenges and difficulties associated with finding the best options. We conceptually apply Computational Complexity Theory (CCT) to assess the challenges associated with decision making. We argue there is scope to build further on the strategic decision-making research domain integrating the rational and bounded rationality principle-based theories with multidisciplinary aspects including computational complexity theories to better explain all aspects of decision-making process.

Keywords: Strategic Decision Making, Computational Complexity Theory, Top Management Team, Decision-Makers.

1. Introduction

Strategic management is a comprehensive approach to change management in organizations, that involves positioning the organization through strategy planning, real-time strategic response to issues and resistance during strategy implementation (Ansoff et al. 2019).Effective strategic management and comprehensive strategic planning leads to the long-term survival of organizations (Betts and Ofori 1992). Strategic planning deals with defining an organization's direction. Strategic management enables the process of determining and achieving that direction. Strategic decision-making is central to the strategic management process. SDM encompasses the basic decisions that determines an organization future at any point in time (Eisenhardt and Zbaracki 1992). Decision-making is a major role of managers in any organization (Nooraie 2012). Getting this strategic decision making right serves an organisation immensely by aligning its internal operations with external environment. This alignment is required to handle threats and challenges faced by the organization and retain its competitive position. Conversely, even one bad strategic decision can take an organization downhill and cause major economic losses to its stakeholders (Mueller, Mone, and Barker 2007).Managers at different levels in the organizations take many decisions on a day-to-day basis to run the business in todays' increasing global environment. Some of these decisions are strategic in nature while other are more tactical. Globalization aids in the faster growth of the organizations and the managers are tasked with a high level of thinking to make best use of all the suitable opportunities to mitigate the threats faced by the organization.

Top management teams and other managerial level decision makers are involved the decision-making process. Decision-making process typically involves steps such as problem definition, decision factors identification, potential alternatives identification, alternatives analysis, best alternative selection, decision execution and an evaluation system to assess outcomes. Many scholars over past decades have attempted to study the process of strategic decision making (Papadakis and Barwise 2002)and develop relevant theories to explain the process. Standard theories of choice literatures across strategic decision-making studies view decision making as deliberate, significant action considering the available alternatives, expected outcomes, consistent preferred sequencing and decision rules(March 1991). Various research studies performed over the years largely focused on the choice paradigms such as rationality, bounded rationality, power, politics, garbage can model(Eisenhardt and Zbaracki 1992), bargaining, participative, incremental, punctuated-equilibrium, polis decision models (Allen C., D. and Coates, B. 2009), game theory, prospect theory, and many learning models (Bossaerts and Murawski 2017).

On the other hand, computational complexity theory is considered as a central theoretical foundation in the field of computer science and deals with the study of the inherent complexity of computational task (Goldreich 2008). CCT studies typically research on the computational resources needed to develop a solution fora computational problem and the effect of limiting these resources as part of solutioning. The computational complexity of a problem is mainly concerned with mapping of input and output. Computational complexity of an algorithm computing a solution, is referred as the expansion or increase in computational resources with reference to the size of the input(Arora and Barak 2007). Inherent complexity of the problem is determined by studying the increase of computational resource requirements. CCT studies commonly involve studying about the number of computational operations and the space or memory required to solve the problem. Studies on the number of computational operations is referred as time complexity and that on the space or memory is referred as space complexity (Bossaerts and Murawski 2017).

2. Review Methodology

Strategic decision making and computational complexity are areas of ongoing research for scholars worldwide. Many scholars have undertaken systematic research and literature reviews on these topics over the years. To make an effective use of available literature on the topic, we adapt 'Narrative Review' method for our research. Narrative reviews, also known as 'Descriptive review,' are one type of literature review methodology. Under this review methodology, we survey only the relevant literature and evidence that are available to take stock on the context of strategic decision-making and computational complexity theory. The method includes extraction of certain specific information of interest from the current existing knowledge on the topic (Paré et al. 2015) and develop a reference literature for scholars. Data collection, analysis and synthesis was performed using a structured method. Data collection for narrative review method is primarily the sources of information for literature search and study. We performed a comprehensive literature search from different electronic databases containing relevant published articles on the research topic. For searching articles, we used keywords and additional words to find relevant articles. On the selection criteria, we included only articles which were related to SDM and CCT topics, particularly which support arguments for integration of the topics and developing a conceptual approach. Our exclusions include articles that were not related directly to the focus of the study.

The narrative literature review method takes a privileged spot in the scientific research domain as it serves as a bridge between the wide spread and dispersed articles on a research topic of interest(Baumeister and Leary 1997). This enables scholars and other readers with a well compiled literature, both for theory creation and theory evaluation. Narrative review method with overviews on the research topic are immensely helpful as educational articles as they collate vast information together into a summarized readable form for the educational community (Green, Johnson, and Adams 2006). The narrative review method used for the current research is presented in figure 1.

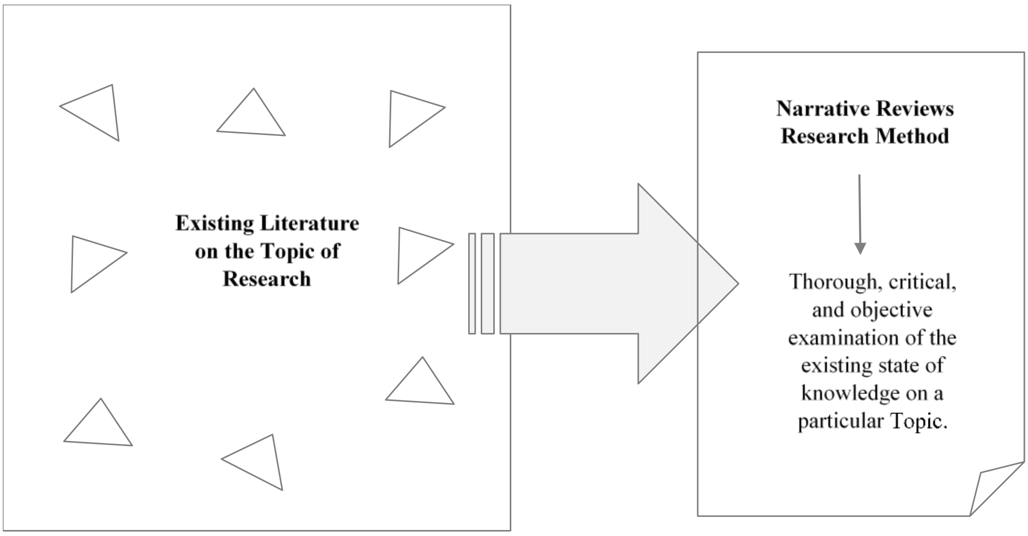

Figure 1. Narrative reviews method

3. Literature Review

Strategic decision in an organization is both an art and science. A combination of science of management and art of leadership (Allen C., D. and Coates, B. 2009). A strategic decision is defined as a set of definite commitment in the form of resources to drive actions (Mintzberg, Raisinghani, and Theoret 1976). A strategic decision process is argued by Mint berg as a set of actions taken by an organization to set precedents, commit resources to manage dynamic factors in the operating environment. Dynamic factors are initiated with a stimulus for action and associated definite commitment to act. There are many commonly applied decisions paradigms in place and this article takes a literature tour of them along with computational complexity theory to draw research insights. The literature on key SDM and CCT theories is summarized in this section.

3.1 Strategic decision-making theories

Numerous studies have been performed over many decades focused on the strategic decision making and choice paradigms such as rationality, bounded rationality, power, politics, garbage can model, bargaining, participative, incremental, punctuated-equilibrium, polis decision models, game theory, prospect theory, and many other learning models.

We undertake a narrative literature review of some of the key theories related to SDM. Rational model forms the most basic decision-making paradigm. Rational model assumes that a manager encounters the decision-making situations with known set of objectives. Decision-makers gather all required information, develop alternative choices or actions and choose the most optimal decision (Simon 1955). On the other hand, for bounded rationality, a central concept in behavioral economics deals with the rational choices with due consideration on the cognitive limitations of the decision-maker. Cognitive limitations can be in the form of decision-makers knowledge and the computational capacity(Simon 1990). Political model of SDM views a business organization as a political system (March 1962)with coalitions of people with conflicting interests (Long and Allison 1972) and the decision made as the choice of the powerful people in the organization (Smigel and Baldridge 1972). Power dimension of strategic decision making include aspects such as cooptation, lobbying, coalition formation, control of agenda (Julius and Pfeffer 1993) and enhancing power through use of information (Eisenhardt and Bourgeois 1988). A Garbage Can decision making model supports on the existence of organization anarchies (Cohen, March, and Olsen 1972), random convergence of problems, solutions, choice opportunities and people(Axelsson, March, and Olsen 1977) and decision becoming increasing robust with longer timeframes, relaxation of deadlines and decline of institutional forces (Axelsson et al. 1977). Garbage Can model of decision making requires lesser number of decision factors and alternatives.

Bargaining is described as a communication process to establish terms of a thoughtful trade (Coddington 1973). Coddington argues that this interpretation of bargaining places restrictions on the decision analysis process. Bargaining decision making process involves individuals within an organization and between representatives' of the organizations(Allen C., D. and Coates, B. 2009). Bargaining model supports specifying formal rules (Baron and Ferejohn 1989)negotiation principles, groups makings tradeoffs between competing agendas and interests. The model promotes identifying common interests and mutual benefit for both the parties involved in bargaining. Participative decision-making model is considered an extension to bargaining approach offering opportunities for parties affected by the decision to get engaged with the process of decision making. The model supports decision making by the very individuals who are involved in executing the decisions and organizational operations (Lowin 1968). Participative decision-making is a form of democratic decision making process offering a chance for everyone to provide their inputs and exert influence (Allen C., D. and Coates, B. 2009). Incremental decision-making model proposed by Charles Lindblom views decisions as small analytical increments responding to circumstances and events. Decision-makers use their familiarity and well-known experiences for incremental decisions (Lindblom 1959).The number of decision factors and solution alternatives are reduced significantly by this model. Some of the characteristics of incremental model include consideration of only few options; negotiated settlements; gradual changes over time and reactive decisions (Allen C., D. and Coates, B. 2009). Punctuated-equilibrium model proposed by Baumgartner and Jones(Baumgartner, True, and Jones 1999)argue that the shifting nature of issues definition and emerging key actors who set the agenda for decision making as two main factors driving decisions in an organization. This contributes to stasis and further significant changes in decisions. This is followed by sustained changes in the form of routines, culture, predictability, bureaucracy, and bounded rationality. The Polis model proposed by Deborah Stone is focused on shared interests, community, cooperation and self-interest. The driving forces for decisions are rules, power, rights and inducements (Stone 2012). Overall polis model acknowledges that decisions are taken by decision-makers with less reliable and incomplete information.

Game theory of decision making rooted in the works of John von Neumann and Oskar Morgenstern(Neumann and Morgenstern 1944), is a theoretical framework for decision making. It supports interactions among rational actors and argues that optimal decisions are taken when there are competing and independent actors in a strategic situation. Prospect theory developed by Daniel Kahneman and Amos Tversky (Kahneman and Tversky 1979)is a psychological theory of decision-making. It is also known as loss-aversion theory as it states that decision making happen under various conditions of risk. According to prospect theory, decision-making is about selecting among available biased judgments-based options. A summarized view on existing major rational and bounded rationality decision-making paradigms is presented in figure 2.

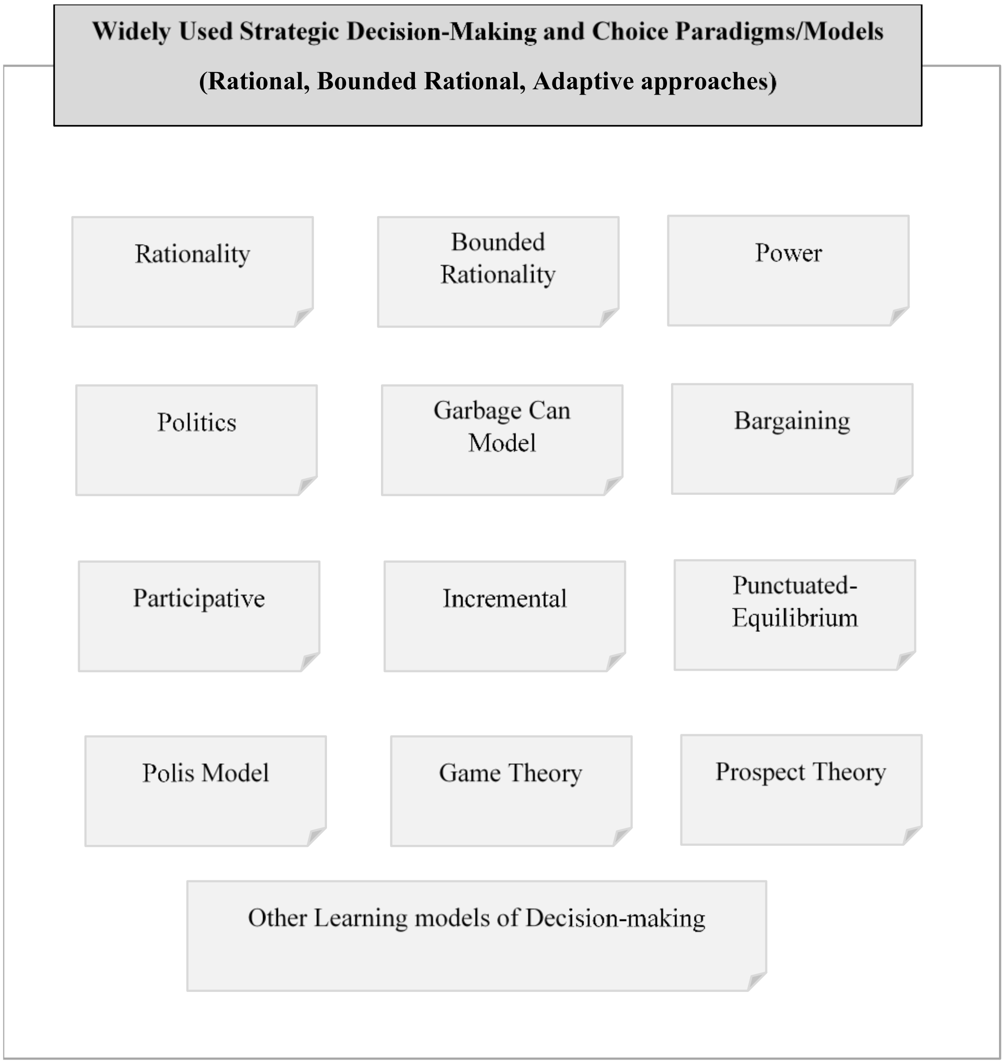

Figure 2. Widely used SDM and Choice Paradigms

3.2 Computational complexity theory

Computational complexity theory is applicable for computable problems(Turing 1937). A computable problem is a problem that can be defined as a mathematical statement and solved by an algorithm with a finite number of steps. The output from algorithm determines whether the statement is true or false. Computational complexity of an algorithm is dependent on the required computational resources and the input (Arora and Barak 2007). An increase of computational resource requirements determines the computational complexity of the problem. In other words, the demands on computational resources as a function of the input size defines the complexity of the problem (van Rooij 2008). The representation of complexity in terms of a function of the input size is natural and appropriate. There are two types of CCT studies, First, time complexity studying about the number of computational operations. Second, space complexity studying the space requirements. A human decision-making process, in our context of study of strategic decision making by a managerial staff is concerned with the time complexity and we will accordingly focus on the time complexity aspects of CCT. The space complexity aspects is indirectly addressed by studying the time complexity as per the general principle that accessing memory space requires time and the amount of memory space to be consumed for a computation is upper bounded by the amount of time that is required to be consumed(Garey and Johnson 1979). Computational complexity theory deals with the quantitative dimension of computational problem and is widely applied for measuring the complexity of computing functions(Hartmanis and Hopcroft 1971). There are proven algorithms to solve computationally lesser complex problems such as minimum spanning tree, shortest path, Euler graph. As the complexity of the problem under consideration grows, the challenges of clearly and quantitatively defining it become a complex task. This type of computational problems is generally unsolvable by algorithms, even when provided with unlimited time for solving.

Time complexity problems are of four classes. First class of problems is called as P class. P class problems are solvable at a certain amount of time. The amount of time required for solving the problem increases as a polynomial of the input size, using a deterministic sequential mathematical model such as a Turing machine (Turing 1937).There are existing algorithms for solving P class of problems and are referred as efficient. This class of problem can be solved within certain amount of time reasonable as per the upper-bound of the polynomial function of its input size. Every P class problem can be approximated by a randomized polynomial time algorithm. Computational models such as Turing machine is used to solve problems where the resources like time can be defined in terms of natural machine models (Saluja, Subrahmanyam, and Thakur 1995). Class P problems are also known as tractable problems. Second class of problems is referred as Nondeterministic Polynomial (NP) problems. This class of problems has characteristic that no polynomial-time algorithm exist to the solution however a given solution can be evidenced in polynomial time(Cook 1971).NP class of problems are referred as intractable problems as finding the solution is generally intractable. Many practical computational problems we encounter is part of NP class of problems as the computational resources required to develop solution such as time is not available (Currin et al. 2017).The solution of this class of problems can be guessed and are verifiable in polynomial time. No specific rule is defined or followed to arrive at the guess solution.

Third class of problems is referred as NP-complete and accommodates the hardest problems in NP(Book 1975). NP-complete problem is a class of computational problem with no efficient solution algorithm. There are two properties for NP-complete problems. First, they have no efficient known solution but can be quickly verified. Second, every NP-complete can be reduced to a decision problem in polynomial time. The satisfiability problem, knapsack problem, the travelling salesman and graph-covering problems are few examples of NP-complete problems(Bossaerts and Murawski 2017). Fourth class of problems is referred as NP-hard. Np-hard comprises of all problems that are hardest problems in class NP that are excluded in class NP (Knuth 1974). Time needed to solution the NP-hard problem is observed to increase exponentially as the instance size increases. One example of this class of problem is the shopping problem. Computational problems in NP-hard class include many models of cognition. Despite great amount of research by scholars and computer scientist over many year, there is no polynomial-time algorithm for computing an NP-hard function(van Rooij 2008). The four classes of problems in computational complexity theory are presented in figure 3.

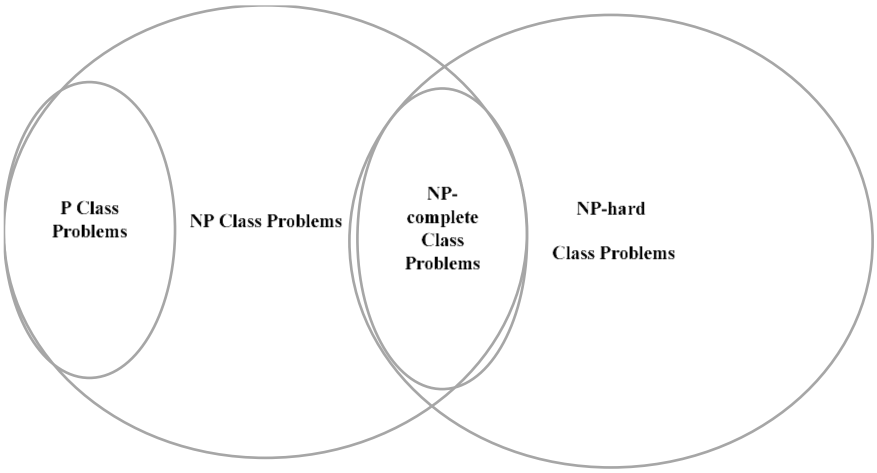

Figure 3: Classes of problems in CCT

4. Discussion and Conclusions

Strategic decision-making paradigms widely studied and argued by research scholars are largely based on the principles of rationality or bounded rationality. These paradigms assume that the decision-makers have adequate or semi-adequate information to select the best alternative as part of decision making. Bounded rationality also assumes decision makers to optimize their decisions among the constraints. The main research gap not comprehensively addressed by most of rational and bounded rationality models is on the process of how the decision-makers identify the optimal decision and the associated difficulties. There are ongoing research efforts to explain the human decision-making process beyond the rational approaches (Koechlin 2020).The Adaptive approaches argue the decision makers to use heuristics during decision making (Leave et al. 1994). Adaptive heuristic techniques discussed as part of bounded rationality approaches (Gigerenzer 2001) argue on the use of appropriate informal methods to choose alternatives among difficulties, that may be sub optimal but may be adequate considering the time constraints.

Some of the recent researches consider the computational complexities associated with decisions (Griffiths, Lieder, and Goodman 2015), attempt to address the difficulties associated with decision making proposing a computational rationality approach (Gershman, Horvitz, and Tenenbaum 2015). These modern theories attempting to address difficulties in decision making by computational rationality again end with rationality principle of optimal solution, leaving the dimensions of decision difficulties such as computation time and costs unaddressed. The research gap being how to practically quantify and analyze the computational resources required by the brain of decision makers during the decision-making process, making it a case of NP-complete or hard class of problems as per computational complexity theory. Optimizing a decision by choosing the best alternative is often computationally intractable as the computational resources needed to compute the optimal solution will require more resources than that is available to decision-makers(Bossaerts and Murawski 2017).

Computational complexity theory is increasingly becoming an integral part of decision making under uncertainty research in recent times (Bossaerts, Yadav, and Murawski 2019) by presenting the behavioral aspects of decision making as a computational problem. It is widely acknowledged that a human decision-making process such as strategic decision-making needs computational resources as argued by computational complexity theory. To sum up, the gap which still remains to be addressed comprehensively is that all existing paradigms for strategic decision making are implausible for most decision making situations in organizations as they are not able to adequately quantify the computational resource requirements for the decision makers, in the form of time complexity, space complexity and other computational dimensions (Bossaerts and Murawski 2017).The overlaying aspects of computational complexity theory on the existing rational and bounded rational decision-making approaches and articulation of the research gaps is presented in figure 4.

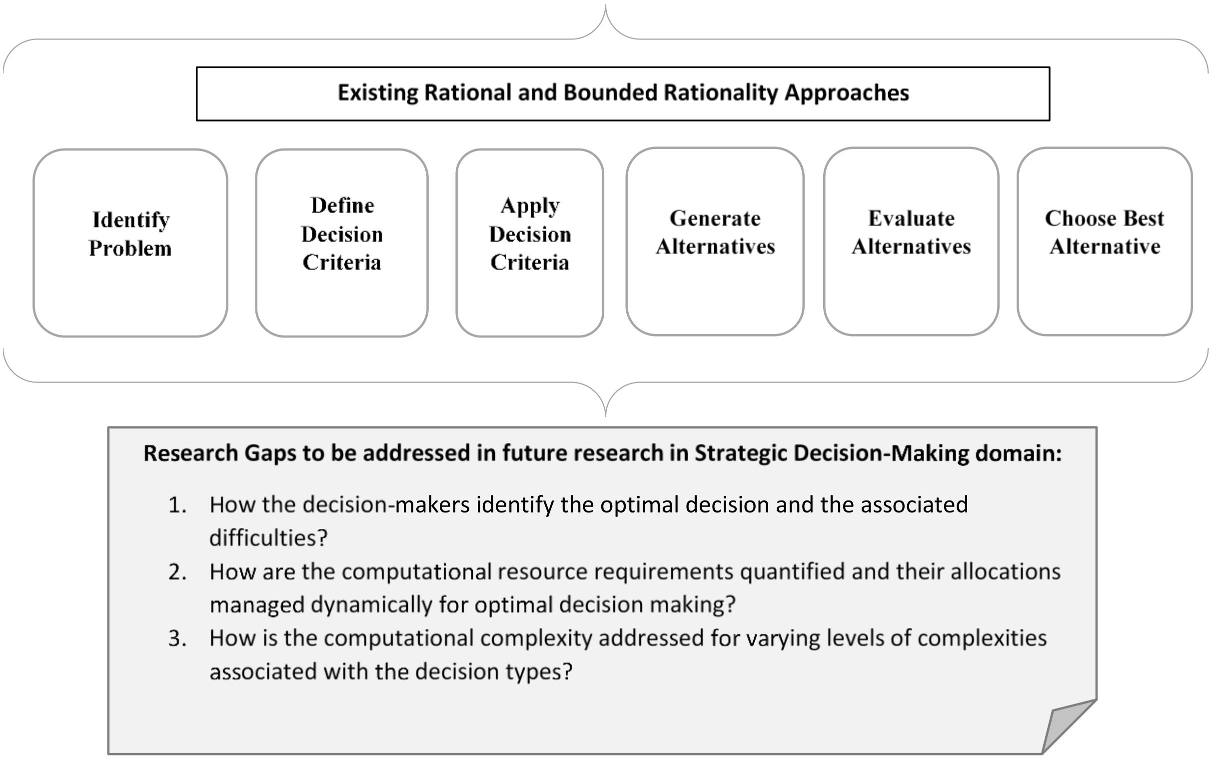

Figure 4: Existing decision-making approach and research gaps

5. Future Research

Decision making is a complex area of research and it is evident from the existing literature on decision making approaches. There is clearly no One size fits all theory or model for decision making. There is scope for research from various dimensions to mainly address the resource allocations and computation complexity to arrive at the best alternatives for decision making. Multidisciplinary research promoting increased integration of disciplines such as computational complexity theories, neurobiology, cognitive social sciences, psychology, computer science (artificial intelligence),dynamic decision making with decision theory is recommended as a way forward to create realistic explanations of the strategic decision-making process and the associated met cognition (cognitive control).

Building on the cognitive rationality research is one such direction but need to include and address the computational resources complexity part adequately to develop more robust approaches for decision making. Also, there are different levels of complexity in each of the strategic decisions made in an organization. Research needs to factor in the varying levels of computational resources required by the human decision makers for such decision and the allocation of resources for processing decisions. This again reiterates the need for research to be more multidisciplinary integrating decision sciences with disciplines of study such as cognitive control or metadecision-making. Future multidisciplinary research efforts to address three major research questions. First, how the decision-makers identify the optimal decision and the associated difficulties? Second, how are the computational resource requirements quantified and their allocations managed for optimal decision making? Third, how is the computational complexity addressed for varying levels of complexities associated with the decision types?

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References

1. Allen C., D. and Coates, B., E. 2009. "Strategic Decision Making Paradigms: A Primer for Senior Leaders." U.S. Army War College (July).
2. Ansoff, H. Igor, Daniel Kipley, A. O. Lewis, Roxanne Helm-Stevens, and Rick Ansoff. 2019. Implanting Strategic Management.
3. Arora, Sanjeev, and Boaz Barak. 2007. "Computational Complexity: A Modern Approach." Complexity 1(January). doi: 10.1088/1742-6596/1/1/035.
4. Axelsson, Runo, James G. March, and Johan P. Olsen. 1977. "Ambiguity and Choice in Organizations." The Scandinavian Journal of Economics 79(1). doi: 10.2307/3439574.
5. Baron, David P., and John A. Ferejohn. 1989. "Bargaining in Legislatures." American Political Science Review 83(4). doi: 10.2307/1961664.
6. Baumeister, Roy F., and Mark R. Leary. 1997. "Writing Narrative Literature Reviews." Review of General Psychology 1(3). doi: 10.1037/1089-2680.1.3.311.
7. Baumgartner, Frank R., James L. True, and Bryan D. Jones. 1999. "Punctuated-Equilibrium Theory Explaining Stability and Change in Public Policymaking." Theories of the Policy Process, 2nd Edition (April).
8. Betts, Martin, and George Ofori. 1992. "Strategic Planning for Competitive Advantage in Construction." Construction Management and Economics 10(6). doi: 10.1080/01446199200000049.
9. Book, Ronald V. 1975. "Richard M. Karp. Reducibility among Combinatorial Problems. Complexity of Computer Computations, Proceedings of a Symposium on the Complexity of Computer Computations,

Held March 20-22, 1972, at the IBM Thomas J. Watson Center, Yorktown Heights, New York, Edited by Raymond E. Miller and James W. Thatcher, Plenum Press, New York and London 1972, Pp. 85–103." Journal of Symbolic Logic 40(4). doi: 10.2307/2271828.

10. Bossaerts, Peter, and Carsten Murawski. 2017. "Computational Complexity and Human Decision-Making." Trends in Cognitive Sciences 21(12).
11. Bossaerts, Peter, Nitin Yadav, and Carsten Murawski. 2019. "Uncertainty and Computational Complexity." Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 374(1766). doi: 10.1098/rstb.2018.0138.
12. Coddington, Alan. 1973. "Bargaining as a Decision Process." The Swedish Journal of Economics 75(4). doi: 10.2307/3439148.
13. Cohen, Michael D., James G. March, and Johan P. Olsen. 1972. "A Garbage Can Model of Organizational Choice." Administrative Science Quarterly 17(1). doi: 10.2307/2392088.
14. Cook, Stephen A. 1971. "The Complexity of Theorem-Proving Procedures." in Proceedings of the Annual ACM Symposium on Theory of Computing.
15. Currin, Andrew, Konstantin Korovin, Maria Ababi, Katherine Roper, Douglas B. Kell, Philip J. Day, and Ross D. King. 2017. "Computing Exponentially Faster: Implementing a Non-Deterministic Universal Turing Machine Using DNA." Journal of the Royal Society Interface 14(128). doi: 10.1098/rsif.2016.0990.
16. Eisenhardt, K. M., and L. J. Bourgeois. 1988. "Politics of Strategic Decision Making in High-Velocity Environments: Toward A Midrange Theory." Academy of Management Journal 31(4). doi: 10.2307/256337.
17. Eisenhardt, Kathleen M., and Mark J. Zbaracki. 1992. "Strategic Decision Making." Strategic Management Journal 13(2 S). doi: 10.1002/smj.4250130904.
18. Garey, M. R., and D. S. Johnson. 1979. "Computers and Intractability: A Guide to the Theory of NP-Completeness (Series of Books in the Mathematical Sciences)." Computers and Intractability.
19. Gershman, Samuel J., Eric J. Horvitz, and Joshua B. Tenenbaum. 2015. "Computational Rationality: A Converging Paradigm for Intelligence in Brains, Minds, and Machines." Science 349(6245).
20. Gigerenzer, Gerd. 2001. "Bounded Rationality - The Adaptive Toolbox: Chapter 3." Bounded Rationality - The Adaptive Toolbox.
21. Goldreich, Oded. 2008. Computational Complexity: A Conceptual Perspective. Vol. 9780521884730.
22. Green, Bart N., Claire D. Johnson, and Alan Adams. 2006. "Writing Narrative Literature Reviews for Peer-Reviewed Journals: Secrets of the Trade." Journal of Chiropractic Medicine 5(3). doi: 10.1016/S0899-3467(07)60142-6.
23. Griffiths, Thomas L., Falk Lieder, and Noah D. Goodman. 2015. "Rational Use of Cognitive Resources: Levels of Analysis between the Computational and the Algorithmic." Topics in Cognitive Science 7(2). doi: 10.1111/tops.12142.
24. Hartmanis, J., and J. E. Hopcroft. 1971. "An Overview of the Theory of Computational Complexity." Journal of the ACM (JACM) 18(3). doi: 10.1145/321650.321661.
25. Julius, Daniel J., and Jeffrey Pfeffer. 1993. "Managing with Power: Politics and Influence in Organizations." Administrative Science Quarterly 38(2). doi: 10.2307/2393418.
26. Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk Daniel Kahneman; Amos Tversky." Econometrica 47(2).
27. Knuth, D. E. 1974. "Postscript about NP-Hard Problems." ACM SIGACT News 6(2). doi: 10.1145/1008304.1008305.
28. Koechlin, Etienne. 2020. "Human Decision-Making beyond the Rational Decision Theory." Trends in Cognitive Sciences 24(1).
29. Leave, Charles, John W. Payne, James R. Bettman, and Eric J. Johnson. 1994. "The Adaptive Decision Maker." The Journal of the Operational Research Society 45(7). doi: 10.2307/2584298.
30. Lindblom, Charles E. 1959. "Science of Muddling Through." Public Administration Review 19.
31. Long, David F., and Graham T. Allison. 1972. "Essence of Decision: Explaining the Cuban Missile Crisis." The Journal of American History 59(1). doi: 10.2307/1888485.
32. Lowin, Aaron. 1968. "Participative Decision Making: A Model, Literature Critique, and Prescriptions for Research." Organizational Behavior and Human Performance 3(1). doi: 10.1016/0030-5073(68)90028-7.

33. March, James G. 1962. "The Business Firm as A Political Coalition." The Journal of Politics 24(4). doi: 10.2307/2128040.
34. March, James G. 1991. "How Decisions Happen in Organizations." Human–Computer Interaction 6(2). doi: 10.1207/s15327051hci0602_1.
35. Mintzberg, Henry, Duru Raisinghani, and Andre Theoret. 1976. "The Structure of 'Unstructured' Decision Processes." Administrative Science Quarterly 21(2). doi: 10.2307/2392045.
36. Mueller, George C., Mark A. Mone, and Vincent L. Barker. 2007. "Formal Strategic Analyses and Organizational Performance: Decomposing the Rational Model." Organization Studies 28(6). doi: 10.1177/0170840607075262.
37. Neumann, John Von, and Oskar Morgenstern. 1944. Theory of Games Ew: And Economic Behavior. Vol. 1.
38. Nooraie, M. 2012. "Factors Influencing Strategic Decision-Making Processes." International Journal of Academic Research in Business and Social Sciences 2(7).
39. Papadakis, V. M., and P. Barwise. 2002. "How Much Do CEOs and Top Managers Matter in Strategic Decision-Making?" British Journal of Management 13(1). doi: 10.1111/1467-8551.00224.
40. Paré, Guy, Marie Claude Trudel, Mirou Jaana, and Spyros Kitsiou. 2015. "Synthesizing Information Systems Knowledge: A Typology of Literature Reviews." Information and Management 52(2). doi: 10.1016/j.im.2014.08.008.
41. van Rooij, Iris. 2008. "The Tractable Cognition Thesis." Cognitive Science 32(6). doi: 10.1080/03640210801897856.
42. Saluja, S., K. V. Subrahmanyam, and M. N. Thakur. 1995. "Descriptive Complexity of #P Functions." Journal of Computer and System Sciences 50(3). doi: 10.1006/jcss.1995.1039.
43. Simon, Hebert. 1990. Bounded Rationality. In Utility and Probability.
44. Simon, Herbert A. 1955. "Rational Decision Making in Business Organizations Herbert A . Simon." Quarterly Journal of Economics 69(1).
45. Smigel, Erwin O., and J. Victor Baldridge. 1972. "Power and Conflict in the University: Research in the Sociology of Organizations." AAUP Bulletin 58(1). doi: 10.2307/40224557.
46. Stone, Deborah. 2012. "Chapter 3 of Policy Paradox: The Art of Political Decision Making." in Policy Paradox: The Art of Political DEcision Making.
47. Turing, A. M. 1937. "On Computable Numbers, with an Application to the Entscheidungsproblem." Proceedings of the London Mathematical Society s2-42(1). doi: 10.1112/plms/s2-42.1.230..