Revista JRG de Estudos Acadêmicos, Ano 5, Vol. V, n.11, jul.-dez., 2022.

(CC BY 4.0) | ISSN 2595-1661

DOI: 10.5281/zenodo.7411673

ARK: https://n2t.net/ark:/57118/JRG.v5i11.461

Complexity planning comparative approaches

Abordagens combativos de planejamento complexo

Recebido: 27/10/2022 | Aceito: 04/12/2022 | Publicado: 07/12/2022

Alessandro Aveni[1]
https://orcid.org/0000-0001-6266-6818
http://lattes.cnpq.br/0679425851663633
Universidade de Brasília, UnB, DF, Brasil
E-mail: alessandro@unb.br

Abstract

Planning complexity is an underestimated process that uses poor tools and was little discussed as a method in the project management literature. The more complex the human organization the more problems are all over the process. Tools, methods, and theoretical understanding of a complexity plan needed to be evaluated as a whole and they must encompass all human organization and environmental change aspects. The paper explains the theory and the reference tools and, as a result, suggests developing strategies and cooperative decision-making tools before starting planning complexity. The more complex the plan the more stakeholders are needed to decide and cooperate with the planners. It is fallacious to try to shortcut the process needs using digitalization or other cost-saving tools with an expectation of being more efficient. As the complex plan is not easy to define and forecast, the entropy of the system is reached only raising energy or costs to manage all the problems that spread up when the plan starts. It is not a problem of inefficiency and a cause-effect process.

***Keywords*:** Public Administration. Project Management. Complexity

Resumo

A complexidade do planejamento é um processo subestimado que utiliza ferramentas precárias e foi pouco discutido como método na literatura de gerenciamento de projetos. Quanto mais complexa é a organização humana, mais problemas existem em todo o processo. Ferramentas, métodos e compreensão teórica de um plano de complexidade precisam ser avaliados como um todo e devem abranger todos os aspectos da organização humana e das mudanças ambientais. O artigo explica a teoria e as ferramentas de referência e, como resultado, sugere desenvolver estratégias e ferramentas de tomada de decisão cooperativa antes de começar a planejar a complexidade. Quanto mais complexo o plano, mais partes interessadas são necessárias para decidir e cooperar com os planejadores. É falacioso tentar encurtar as necessidades do processo usando a digitalização ou outras ferramentas de economia de custos com a expectativa de ser mais eficiente. Como o plano complexo não é fácil de definir e prever, a entropia do sistema é alcançada apenas elevando energia ou custos para

[1] Doutor em Administração. Mestre em Geografia. Bacharel em Administração. Docente da UnB e do Docente do UniPROCESSUS.

gerenciar todos os problemas que se espalham quando o plano começa. Não é um problema de eficiência e não trata-se de um processo de causa e efeito.

Palavras-chave: *Administração Pública. Gerenciamento de Projetos Públicos. Complexidade*

1. Intruduction

Business Organisations Tools developed for complexity management are today inadequate when facing problems like global trade and global environmental issues. We can see this when considering multiple stakeholders, multiple services, financing projects, and the legal framework, less flexibility in process workflow, compliance, more controls, and the issues between increasing bureaucracy (Aveni, 2022).

If the strategy and structure of a plan could be easily defined and found, tools for complexity along with the implementation management, are actions mostly underestimated? Something simple is going wrong because the command chain is too long and it is difficult to coordinate complexity. The complex plan process includes different levels of discussions and decentralization.

The major problem is the Plan Organisation inertia. Complexity plan management could not be implemented only by consultancy organizations and tools because the cause-effect rule implies increasing energy and spread encompassing more stakeholders than expected when complexity is raised. Managing a complex plan is similar to developing predictions for chaos. At every milestone, the organization faces new problems to be included in the initial path of the implementation forecast.

The actual research paper aims to discuss the complexity of planning arguing there is an increase of energy not only to manage the change but also to maintain the entropy level achieved. So, this paper is a research of different approaches to complexity plans and justifies itself because many complex plans today are missing to achieve results.

We hypothesize that when is needed to perform a complex plan it is impossible to perform the plan without a huge amount of energy even using digitalization and modern technological platforms. There's an inverse relationship between time and performance in complex plans. The less time we have the more complexity we need to face during the implementation. We justify the research because it is necessary to rethink the basic planning approach today and bypass the use of a single tool and consultant firm with poor expertise increasing stakeholders' convergence to minimum result.

We discuss different approaches and methods to manage and plan complex programs and plans using bibliographic research. The research starts with a discussion about complete and complex planning. A comparative table ends the research and conclusion remarks end the paper as well as bibliographic references.

2. Methodology

The methodology of the paper is a deductive reasoning that proceeds from general information to specific conclusions. The primary hypothesis is that the more complex is the planned goal the more energy and tools have to be developed being impossible to shortcut the process using digitalisation or other efficient looking tools. Methodological procedures used to confirm the hypothesis are documentary research on complexity and planning, looking for connections and comparative assessment.

If the hypothesis is confirmed by the discussion, it seems necessary to develop more tools and methods than the ones actually used. The base of new tools is not the structured planning but a new method based on learning processes.

The steps developed are the follows: a) clarify the actual planning and the link between complexity and planning: b) actual tools and methods used to manage complex planning; c) results and conclusions.

3. Discussion and results

Complexity and human organizations.

To plan is a human act like others. Organizations today are working collaboratively much more than in the past. Collaboration is a complex process much more when multicultural and global processes are starting to solve global problems.

To reference complexity and human organization we must read Humberto Maturana's theory which is the most recent complex view about the self-generating, self-maintaining structure in living systems, and concepts such as structural determinism and structural coupling. Some implications of the Autopoiesis and Cognition theory are worth to be resumed here according to Marturana (1970).

(i) Man is a deterministic and relativistic self-referring autonomous system whose life acquires its peculiar dimension through self-consciousness; ethics and morality arise as commentaries that he makes on his behavior through self-observation. Accordingly, no absolute system of values is possible and all truth and falsehood in the cultural domain are necessarily relative.

(ii) Language does not transmit information and its functional role is the creation of a cooperative domain of interactions between speakers through the development of a common frame of reference, although each speaker acts exclusively within his cognitive domain where all ultimate truth is contingent to personal experience. Consequently, no one can ever be rationally convinced of a truth that he did not have already implicitly in his ultimate body of beliefs.

(iii) Man is a rational animal that constructs his rational systems as all rational systems are constructed, that is, based on arbitrarily accepted truths (premises); being himself a relativistic self-referring deterministic system this cannot be otherwise. But if only a relative, arbitrarily chosen system of reference is possible, the unavoidable task of man as a self-conscious animal that can be an observer of its cognitive processes is to explicitly choose a frame of reference for his system of values

A living system as a human or a human organization is not a goal-directed system and this implies that all organizations are not goal-directed without constraint. The functioning of the self-referring system itself must be included in the explanation of the system features of interactions (descriptions) that belong also to the cognitive domain of the observer.

Following Maturana and Varela's conclusions all living systems are cognitive systems, and living as a process is a process of cognition. And we argue that the same could be said by analyzing human organizations as a living collaborative structure built by humans. This conclusion was a well know result of the discussion by Senge in the 1990s with the book The Fifth Discipline (Senge, 1990), in which he developed the notion of a learning organization. This learning organization conceptualizes organizations as dynamic systems (as defined in Systemics), in states of continuous adaptation and improvement.

So that view of a human organization fit also into organizations that start service processes and must be used when there is a need for a change or to develop projects and programs that imply organizational impacts.

This humanistic approach differs from an engineering or technological view of project management because this last is more deterministic and implies a clear direction, or a tight line of command and little discussion of goals and achievement. Bureaucracy is one tool of such a deterministic view of management services and administration that came from an XVIII-century conception well described at the end of the 19th century by German sociologist Max Weber. Bureaucracy is an organizational structure that is characterized by many rules, standardized processes, procedures, and requirements, the number of desks, the meticulous division of labor and responsibility, clear hierarchies, and professional, almost impersonal interactions between employees.

Bureaucracy in the XIX and XX centuries help develop the modem international system of nations, trade, and innovation technology, using the scientific positivist logic born lately from French and mostly Kant illuminist philosophy of the XVIII century and their students in scientific historical and political approaches.

However today according to Tom DeMarco and Timothy Lister (1987) efficiency more than hierarchy organization is the new goal of organizations. This is because energy waste as business team inefficiency increases entropy.

The red tape typology suggested as common jargon in business is a metaphor for excessive bureaucracy or adherence to official rules and formalities. The work approach is a consequence of the fact that as was said by the authors: "The major problems of our work are not so much technological as sociological in nature", and this includes the conflicts between individual work perspective and corporate ideology, corporate entropy, "teamicide" and workspace theory.

So, to reduce red tape one could use new rules and digitalization, but one must be aware of the potential conflict and raise energy to be used to change the culture and the organization that produces red tape. In another word, the more bureaucratic the organization is the more difficult to develop teamwork.

The complexity of organizations could be reduced namely by dividing the complexity into a few and main nodes of a web of problems some of them easy to solve than others, but complications have few solutions because of the difficulty to achieve a problem solution.

To work with divided complexity is needed to identify these nodes of a web of problems. A classification of complexity according to Vidale e Merkel (2008) identified four drivers of complexity: a)project size factors; b) project variety. c) interdependencies and interrelations within the project system d) project complexity context-dependence.

Figure 1. Drivers of project complexity

Font: Vidale e Merkel (2008)

However accordantly to van Schooten (2019) highly complex and uncertain projects often do not have clear expectations. When complex projects start there are two questions to be answered: what are the characteristics where the approach of the project is uncertain? and which theories and/or tools can be developed to support project management in this case? So two tools were developed: 1) the points of attention model consists of three project phases, the starting, executing, and concluding phases, and five tracks: Stakeholders, Resources, Goal(s), Project Structure, and Communication 2) identify gaps in the values of the group of stakeholders. The difficulty of finding clear expectation drive us to an agile process or a process not structured. The agile method will be discussed also later in this paper.

Snowden and Kurtz (2003). discussed a matrix in which is possible to understand the level of complexity of an organization. From obvious to complicated, complex, chaotic, and confusing the framework help to identify the perceiving situations. The idea of the so-called Cynefin framework, which was developed using the idea of habitat, is that it explains that all have connections, such as social and geographical, of which we may not be aware. In the matrix domains on the right (clear and complicated) cause and effect are known or can be discovered. On the left, in the domains (complex and chaotic) cause and effect can be deduced only with hindsight or not at all.

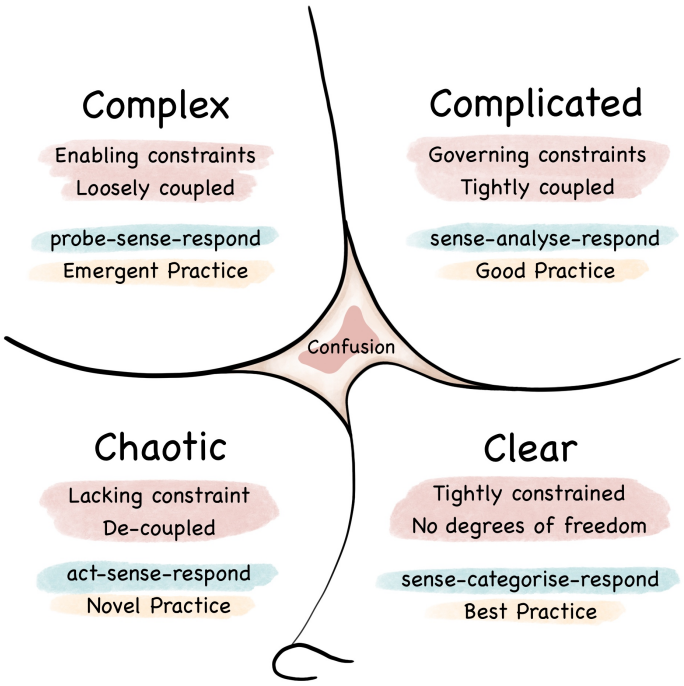


Figure 2 - Cynefin framework

Font: By Tom@thomasbcox.com - Own work - a re-drawing of the prior artwork found here (https://commons.wikimedia.org/wiki/File:Cynefin_as_of_1st_June_2014.png) that incorporates more recent changes, such as renaming "Simple" to "Clear"., CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=123271932

In other words, using the Cynefin matrix the planners may see that there is a land of unstructured situations when, in the worse situation, the planner could have no control but also no idea of problems and consequently the tools to use. The situation is complex and complicated. These wicked situations are not the complex domain itself but the situation in which all domains must be managed at the same time. This is the center of the matrix and it can be called confusion.

If we try to understand the relationship between digitalization and complexity because it seems that digitalization could reduce complexity and confusion, and even complication, there is a belief that digitalization reduces workload and complexity. In that sense reducing workload and reducing complexity with digitalization is good and could be included as one goal of a plan. Could also be included in a plan to minimize the energy that could be spent without digitalization. This cause-effect is not proven. And even if it is a confusing situation, if there is one, is not erased from the plan.

Moreover, the relationship between complexity and planning, passing or not through digitalization needs a methodology to manage the situation. Whatever method agile or structured is used to develop and implement plans for a project and its following plan to execute it is always something unique and follows a formalized process. As a general definition, the process is a step-by-step implementation divided into a starting phase, planning, implementation, and the ending phase before the end of the project (PMbok 2021). The control and monitoring phases are developed from the planning till

the end to assure the plan is implemented following a structure and to reach all objectives. The synergy between phases and people must be complete and performed with many tools and with a responsible or a bunch of a few facilitating experts.

Sometimes the project coordination and control underestimate the ending phase of a single sprint in an agile performance or the final and ending phase of a structured project. Several little issues are sometimes left to the next step and these accumulated like the famous butterfly effect in chaos theory (Lorenz, 1972). In other words, in a complex plan the sensitive dependence on initial conditions in which a small change in one state of a deterministic nonlinear system can result in large differences in a later state.

The Chaotic level is the riskiest as the one that has less opportunity to be managed. Chaos Theory became popular with weather model studies in the seventies of the XX century. Among other scholars Edward Norton Lorenz

Predictability: Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas? by Edward N. Lorenz Presented before the American Association for the Advancement of Science, December 29, 1972

noted that the there is effect is derived from the details of a tornado being influenced by minor perturbations. Then to explain the problem was created a poetical example was such as a distant butterfly flapping its wings days or weeks earlier starting air perturbations.

Structured planning suffers most, till the start, the changes, like a bullet with a wrong direction, but also agile planning cannot perform a good hit with a wrong initial direction and even a sub-optimal solution. Chaos considerations and theories must be useful in a complex plan and must be well-considered before starting.

Planning and complexity

In the previous section, we discuss the complexity of organizations but when an organization must perform its actions to reach its own goals, the process starts with a plan

Between recent work using a complex approach to plans, as a quantitative approach, Jussi Rintnen (1999, 2004) shows that for conditional planning with partial observability, a problem of testing the existence of plans with success probability 1 is 2-EXP-complete. The complexity of conditional planning with different combinations of restrictions on plan sizes and execution lengths as well as the reference works of constructing and evaluating policies with the restriction to finite-horizon performance.

Sophie Yates and Helen Dickinson (2021) underline, that wicked problems are to be resolved within contingent phenomenon and poly-centric governance arrangements. In this process, the authors show integration complexity theory and methods with a focus on system levels of governance trying to harness complexity.

Lowe and others (2021) stress an alternative model of public management termed the 'Human LearningSystems' (HLS). Following the presentation, HLS appears to have provided a language for expressing shared practices, HLS has sparked sharing among organizations pursuing complexity-informed and collaborative practices because acts as a connective framework in this complex context overlapping the limitations of the current methodological orthodoxy (Mowles, 2014 & OECD, 2017).

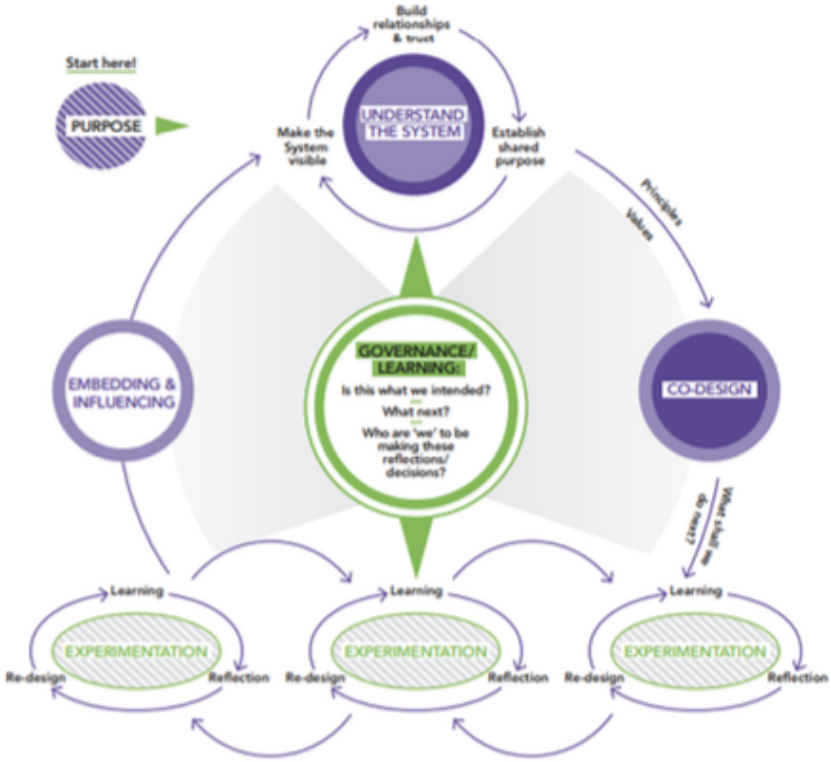


Figure 3 - Human LearningSystems

Font: https://john-mortimer.medium.com/human-learning-systems-hls-an-evolution-of-service-design-ffad3069907e - https://www.centreforpublicimpact.org/insights/human-learning-systems-a-practical-guide-to-doing-public-management-differently.

In contrast many tools developed to handle complexity Plans were developed by Consultancy or Project Planner Organisations. These are based on engineering structured models or agile models. To use an agile perspective doesn't mean it is used a learning framework but a flexible one. As the manifesto[2] said the followers of the method are uncovering better ways of developing software by doing it and helping others do it.

And they add that have come to value: individuals and interactions over processes and tools; working software over comprehensive documentation; customer collaboration over contract negotiation; responding to change over following a plan.In other words learning by doing or be flexible implications to the agile method doesn't imply manage complexity but reduce complications as was described in the discussion section before or to drive chaos to be managed by a method.

All primary planning complex methods of project planning found in the bibliographic research are reducing complications and chaos but not complexity. In this research some methods are missing because of they are less used as the ones discussed here, or because are technique that encompass only part of the phases of manage project or: initiating, planning, executing, and closing.

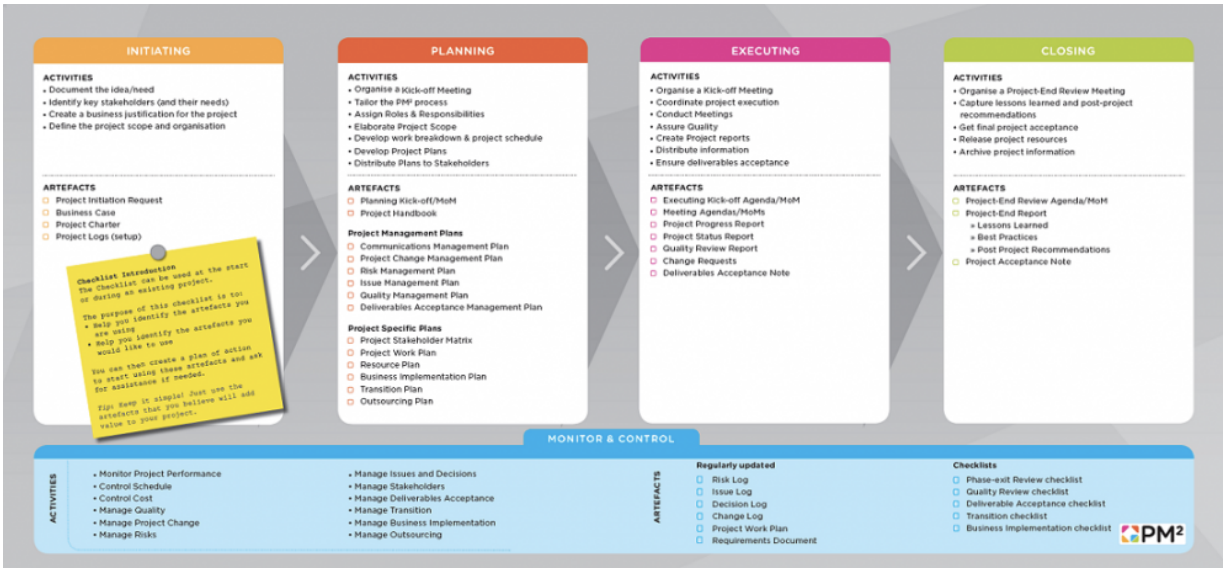
[2] https://agilemanifesto.org/

As a Planning Method to handle such complex plans European Union seeks to use a unified method called PM² (EU 2018), in many ways recalls and is derivate from PMI project management, the waterfalls, and a structured way to manage projects and portfolios. It includes also the use of the agile method. It is a hybrid but more structured than agile.

Many of the PM² best practices can be applied to any type of project or work activity and the whole PM² methodology is in managing projects and include a project (i.e., not operations, not a work activity, not a program, etc.); have a duration of more than 4-5 weeks, with more than 2-3 people involved; runs within an organization and can be subject to internal or external audits; requires a clearly defined governance structure, and assigned roles and responsibilities; requires approval of its budget and scope; includes more than just construction/delivery activities; includes transition and business implementation activities; requires a certain level of documentation, transparency, and reporting; requires a certain level of control and traceability; has a broad base of internal (and external) stakeholders; may require the collaboration of several organizations or several organizational units.

An overview of the PM² methodology is shown in the figure below. So as a planning project method for complexity Europe suggests this PM².

Figure 4 - PM² framework



Font: https://europa.eu/pm2/about-pm2-methodology_en

An example of the not structured complex plan management is The Logical Framework. This approach is familiar to those working in international development. Nowadays the program theory is known as the 'theory of change' following Vogel 2012) was "influenced by the seminal practical guidelines, 'The Community Builder's Approach to Theory Development' that was developed by Anderson (2005) as part of the Aspen Institute's 1990s initiative that involved evaluators and community development programmers in applying program theory concepts to the evaluation of complex community initiatives (Connell & Kubisch, 1998)". Organizations working in international development have found a theory of change thinking a useful approach for exploring and clarifying planning in a particular context, so the theory is used as an integrated project cycle planning, monitoring, and evaluation framework. In particular, the theory

focuses on the pre-planning stages of scoping and strategic analysis, design, and planning before implementation.

Key points of the theory of changes are a) context, actors, and a sequence of logically-linked events leading to long-term change in a complex plan; b) the types, scope, and level of detail and evaluators reflecting different purposes and needs; c) flexible thinking tool than current logical framework approaches (Vogel, 2012 pg.17).

Finally, some academics like Fernandes and others (2018) argue that the "hybrid PM approach" is a better solution to complexity plans. The hybrid PM is based on the contingency theory following Fiedler, F. E. (1993), who proposes a set of Must Have 24 well-known PM practices to assure the program governance. In the Fernandes paper these PM practices are in table 2 (Fernandes and others 2018, pg. 811) and divided into four phases: project initiation, project initial planning, execution, monitoring and control and re-planning, and, lastly, project closure. Also, agile methods are recently criticized by Suryaatmaja and others (2020) for presenting concepts that combine human-centric aspects and knowledge management to improve learning in the organization.

Finally, following the list of the method illustrated till now, a complexity plan governance was reported by PMI (PMI, 2013) as the competencies to manage complex projects as a) create a culture of the project and program management with engaged project sponsors, b) assess and develop talent with a focus on fostering leadership skills, c) communicate effectively with all stakeholder groups. The way forward is to transform complexity into craftsmanship like the Italian Made in Italy design process.

Decreasing complexity from a risk control leads to considering the following three action paths: a) decreasing the number of contributors and the number of levels/ranks of contributors; b) Minimizing their inter-dependencies, both in number and in criticality; c) Increasing the level of control on the contributors to improving their alignment.

A way to reduce the complexity of governance using leadership could be either by reducing the number of stakeholders, or inter-dependencies between them and minimizing natural variability of delivery by involving experienced contributors and/or using technology tools. So, complexity governance is a step before portfolio governance and must be checked with a survey of how well was communicated complexity throughout the team (and in this case all of the Italian Public Administration.

Here in the following summary table, there are three main complex planning approaches of project management discussed above. Again, the discussion of that plan it's only a case due to the author's knowledge and experience, not a specific target of critics because, as far as we know it's difficult today even for corporations to find a best practice of portfolio and complexity plan managing.

In the table, there is a definition of complexity of the main practice detected, the governance of the complexity, and main tools or manual references to implement complexity management.

Table - 1 Summary of tools

Methods	definition of complexity	governance	tools
PMI	Booz Allen Hamilton identifies complexity in projects as "the exponential increase in ambiguity surrounding stakeholder expectations, especially regarding the certainty of program outcomes and schedules.	Human behavior - System Behavior - Ambiguity	PMI Navigating Complexity: A Practice Guide (2014)
PM²	not defined	Project manager expertise using Portfolio management and agile tools	A Value versus Complexity Matrix is a prioritization tool used to rank a set of project needs within a portfolio to achieve a final objective most efficiently.
AGILE Method	No definition - Agility is a way of creating software empirically. Instead of predicting the future, teams learn why, what, and how they need to do something while they go along. Therefore agility is a concept of reducing complexity by breaking down large works into small manageable units.	Use of agile main principles and hybrid theories and/or theory of change	In the most important and popular frameworks Scrum, Holacracy, or Kanban, this concept was revisited. Organizations make sense of a complex environment by making the future as predictable as possible.

Font: By the author, Alessandro Aveni (2022). alessandro@unb.br

To manage projects and plan it using a learning framework it necessary a learning framework as developed by Artificial Intelligence (AI) based on decisions. The decisions of AI are based on probability and shared evidences, but for complex human plans must be added also convergences or sharing and trust decision between group of stakeholders and project managers.

Many tools could be developed and used to complement and strengthen the management of a complex plan. In general, a Checklist of complexity management strategy is an exercise using problem-solving.This Checklist could be summarised as:

Strategic questions before the start
Who we are
What we do
Where do we want to go
Check out a project. The 5w2H technique:
What? What will be done? action, steps, description
Why? Why will it be done? justification, reason
Where? Where will it be done? location
When? When will it be done? time, dates, deadlines
Who? By whom will it be done? responsibility for action
How? How will it be done? method, process
How much? How much will it cost to make? costs or expenses involved

But it is not enough because we need a decision method and priority between different dimensions and focus. In another word, the strategy chosen must be completed by Decision methods.

Here are some examples of decision methods:

Command – One person decides. It might be the main authority figure, or that individual might delegate the power to decide to another specific individual.

Consult – A person given the power to make a decision first consult widely before making a decision. Note: you can listen to someone's opinion without taking on an obligation to use that opinion in your decision.

- Vote – The group votes.
- Consensus – we negotiate a position that everyone can agree to.
- Prioritizing methods examples
- Impact–Effort Matrix
- Feasibility, Desirability, and Viability Scorecard
- Kano Model
- MOSCOW Method
- RICE method

It is impossible to increase the entropy of a complex plan without a huge amount of energy. The complexity of human organizations and the planning of complex projects could prove that, even with the digitalization of the whole process, the focus must be to involve stakeholders and train the workforce to be flexible and skilled in many methods. Digitalization involves organizational changes that have a long-term payback. Virtually the payback have no positive return so the initial input energy (including financial and not accountability or shadow costs figures) must be calculated as a benefit-cost project.

4. Conclusion

The paper discussed the complex approach to planning and project management. The normal approach today is to define a path to reduce the inefficiency of classic planning approaches and make sure to reduce costs. Most organizations use only one method or tool to manage complexity and this is not enough, in our opinion.

Moreover Plan and project processes today could be considered always complex if we want to encompass every aspect of human organizations and stakeholders. This dimension is a new layer of a multidimensional approach to project management (PM).

If our hypothesis was logically proved, the main issue to manage complexity in the first step of a complex plan or to define a strategic approach to complexity plans project management. The learning method to manage complexity must be defined before to define goals or methodology.This implies to define what decision method to be used, tools, how to start a complex project and how to manage.

So then in a complex project, the priority is to manage the multi-focus and, the multi goals with a learning approach. It is needed flexibility and a method of choices (define priority and solve conflict). This initial phase must be discussed with a wide number of stakeholders to be sure the goals are clearly defined and the process follows the right shared path. To use a structured or hierarchical structured decision is risky and could be used only if the complexity could be divided only into complications.

References

Aveni, A. (2022). NEXTgenerationEU a case of public administration complexity programs: a discussion on tools, stakeholders and law. *Revista Juridica da Presidencia Brasilia*, *25*(134).

Buti, M. & Luiss, M. M. (2020). School of European Political Economy, *Next Generation eu*: An interpretative guide Policy, Brief n. 29/2020.

Demarco, T & Lister, T. (1987). *Peopleware*: productive projects and teams. Dorset House Publishing, New York, 1987.

Porte, C., & Jensen, M. D. (2021). The next generation EU: An analysis of the dimensions of conflict behind the deal. *Social Policy & Administration*, *55*(2), 388–402. https://doi.org/10.1111/spol.12709

Dickinson, H., & Yates, S. (2021). From external provision to technological outsourcing: Lessons for public sector automation from the outsourcing literature. *Public Management Review*, 1–19. https://doi.org/10.1080/14719037.2021.1972681

European Commission Centre of Excellence in Project Management (Coepm2). (2018). *The PM2 Project Management Methodology Guide*. 3.0 Current Edition: The PM2 Guide v3.0.

Directorate-General for Budget (European Commission). (2021). *The EU's 2021-2027 long-term budget and NextGenerationEU: Facts and figures*. Publications Office of the European Union. https://data.europa.eu/doi/10.2761/808559

European Commission. (2021). *The EU's 2021-2027 long-term Budget and NextGenerationEU: facts and figures*. (2021b). Available at: https://op.europa.eu/en/publication-detail/-/publication/d3e77637-a963-11eb-9585-01aa75ed71a1/language-en. Access at 5 Oct. 2022.

Fernandes, G., Moreira, S., Araújo, M., Pinto, E. B., & Machado, R. J. (2018). Project management practices for collaborative university-industry r&d: A hybrid approach. *Procedia Computer Science*, *138*, 805–814. https://doi.org/10.1016/j.procs.2018.10.105

Kurtz, C. F., & Snowden, D. J. (2003). The new dynamics of strategy: Sense-making in a complex and complicated world. *IBM Systems Journal*, *42*(3), 462–483. https://doi.org/10.1147/sj.423.0462

Lowe, T., French, M., Hawkins, M., Hesselgreaves, H., & Wilson, R. (2021). New development: Responding to complexity in public services—the human learning systems approach. *Public Money & Management*, *41*(7), 573–576. https://doi.org/10.1080/09540962.2020.1832738

Lorenz, E. N. (1972). *Predictability*: Does the Flap of a Butterfly's Wings in Brazil Set off a Tornado in Texas. American Association for the Advancement of Science, 1972. Available at: https://static.gymportalen.dk/sites/lru.dk/files/lru/132_kap6_lorenz_artikel_the_butterfly_effect.pdf

Mowles, C. (2014). Complex, but not quite complex enough: The turn to the complexity sciences in evaluation scholarship. *Evaluation*, *20*(2), 160–175. https://doi.org/10.1177/1356389014527885

Maturana. (1970): *Biology of Cognition*. http://www.enolagaia.com/M70-80BoC.html.

Organization for Economic Co-Operation and Development, OECD. *System approaches public sector challenges:* working with change. Available at: http://www.oecd.org/publications/systems-approaches-to-public-sector-challenges9789264279865-en.htm. Access on 10 Jun. 2022.

Project Management Institute PMI. (2013). *PMI's Pulse of the Profession In-Depth Report:* Navigating Complexity.

Project Management Institute, PMI. (2021). A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Sixth Edition (English Edition), 6th Project Management Institute.

Rintanen, J. “Constructing Conditional Plans by a Theorem-Prover”. *Journal of Artificial Intelligence Research*, vol. 10, maio de 1999, p. 323–52. *DOI.org (Crossref)*, https://doi.org/10.1613/jair.591.

Rintanen, J. (2004). *The complexity of planning with partial observability*. In: Zilberstein, S., Koehler, J & Koenig, S. (2004). *Proceedings of the Fourteenth International Conference on Automated Planning and Scheduling*, ICAPS 2004345–354. AAAI Press. Availalble at: 11 jun. 2022. Available at: https://www.aaai.org/Papers/ICAPS/2004/ICAPS04-041.pdf

Senge P. (1990). *The fifth discipline the art and practice of the learning organization* 1st ed.

Suryaatmaja, Kevin, et al. “Uncovering the Failure of Agile Framework Implementation Using SSM-Based Action Research”. *Palgrave Communications*, vol. 6, nº 1, janeiro de 2020, p. 8. *DOI.org (Crossref)*, https://doi.org/10.1057/s41599-019-0384-9.

Vidal, Ludovic-Alexandre, e Franck Marle. “Understanding Project Complexity: Implications on Project Management”. *Kybernetes*, vol. 37, nº 8, setembro de 2008, p. 1094–110. *DOI.org (Crossref)*, https://doi.org/10.1108/03684920810884928.

Schooten, R. W. van. *Characteristics of Highly Uncertain and Complex Projects*. 5 de julho de 2019, https://essay.utwente.nl/78790/

Vogel, I. (2012). *Review of the Use of 'theory of change' in International Development*.Review Report, 2012, Department for International Development. Available at: https://www.theoryofchange.org/pdf/DFID_ToC_Review_VogelV7.pdf