

Evaluation and selection of scenario-based digital Transformation Projects

Alexandre Caramelo Pinto¹, Alexandre Acácio de Andrade², Julio Francisco Blumetti Facó³, Jadir Perpétuo dos Santos⁴

¹Instituto de desenvolvimento educacional (IDE), FGV – Fundação Getulio Vargas, Brazil

^{2,3}Center for Engineering, Modelling, and Applied Social Sciences, Universidade Federal do ABC, Brazil

⁴Universidade Cruzeiro do Sul, Brazil

Received: 21 Nov 2020;

Received in revised form:

08 Jan 2021;

Accepted: 04 Feb 2021;

Available online: 12 Feb 2021

©2021 The Author(s). Published by AI
Publication. This is an open access article
under the CC BY license
(<https://creativecommons.org/licenses/by/4.0/>).

Keywords— digital transformation, Industry 4.0, scenarios, portfolio management, information technology and communication

Abstract— The advent of digital transformation, also known as Industry 4.0, has brought considerable challenges to organizations from various industries. The effects of its relevance and intensity can be observed in the relations between organizations, between individuals and the first and governments with these two entities. By encompassing the intense use of information and communication technologies (ICTs), it raises the need for careful evaluation and selection of projects aimed at digitally transforming, business processes, business models and customer experience to interact with the first two. In this sense, portfolio management which includes the evaluation and selection of projects, has numerous methods of analysis ranging from financial tools to strategic approaches. Therefore, selection of the method directly influences the quality of the decision made, as well as obtaining the optimal portfolio of projects. This study is dedicated to exploring the use of scenarios to support the analysis and selection of digital transformation projects. This research is qualitative, exploratory, descriptive in nature and is structured through ground theory method (GTM) applied in 7 (seven) Brazilian telecommunications operators. The main contribution of this study is the proposition of a framework that integrates prospective scenarios of evaluation and selection of projects in organizations in a structured manner helping them to conduct their digital transformation, through the creation of digital capabilities.

I. INTRODUCTION

The digital transformation as envisioned by Andal-Ancion, Cartwright and Yip (2003) positions itself, as a phenomenon that alters the current technological paradigm (Dosi, 1983) and finally, the technological trajectory (Nelson & Winter, 1977) of how business will be done from now on. In a similar proposition, one of the visions of digital transformation appears from the German perspective and is called Industry 4.0 or fourth industrial revolution. This vision addresses innovations with a strong

technological base that affect relations between people and organizations and served as a starting point to improve the competitiveness of German industry since 2011 (Hermann, Pentek & Otto, 2016; Schwab, 2016). In that sense, correct evaluation and selection of innovation projects connected to digital transformation, which occur in portfolio management (Cooper, Edgett & Kleinschmidt, 1999, 2001) shall include not only concepts with a strong technological base such as: big data, cloud computing, mobility, internet of things, artificial and cognitive

intelligence, distributed ledgers technologies (blockchain), consumerization and startups, as well as utilization of decision tools based on scenarios that assures a path to be followed as well as the intermediate scenarios to be reached by organizations (Wack, 1985; Porter, 1986; Schoemaker, 1995; Chermack, Lynham and Ruona, 2001; Meissner and Wulf, 2013).

The objective of this work is to analyze the use of scenarios during the evaluation and selection of innovation projects focusing on digital transformation determining how they influence the trajectory of telecommunications operators towards the desired state, and to offer a theoretical and conceptual framework that integrates prospective scenarios to the evaluation and selection of projects. The intent is that such framework can assist these organizations to conduct their digital transformation, more effectively through capability building efforts.

The relevance of this study can be perceived under the economic impact expected for such phenomenon in various economic sectors. According to World Economic Forum, digital transformation will be responsible for injecting up to US \$ 100 trillion by 2025, being that the portion that relates to the telecommunications sector, considering its potential to influence other interdependent sectors (energy, logistics, automotive industry, retail, and media) it can reach up to 10% of this total (Wef, 2017b).

II. METHOD

The GTM - grounded theory method, applied in this study is a logically consistent set of data collection added to analytical procedures that contribute to the development of a theory through inductive strategies. According to Charmaz (1996, p. 27) it offers “a set of strategies for conducting rigorous qualitative research”, since it has a system for handling and modeling collected qualitative materials. The theory teaches that in addition to revealing relevant conditions, it determines how the stakeholders involved respond to these conditions and the consequences of their actions (Corbin & Strauss, 1990, 2001). In effect, the theory that emerges as a result of grounded theory application is based on the interviewees' voice, acts and experiences (Goulding, 2002). Halaweh, Fidler & McRobb (2008) assert that, typically, an analytical study conducted through grounded theory observes the following steps: coding, concepts, categories, and emerging theory. In essence, the collection and analysis of present work took place in parallel, and from the identification of previously studied concepts, the researchers identified and coded the incidents and events that were potential indicators of the use of scenarios in the evaluation and selection of projects aiming digital transformation.

Thus, the objective was not to obtain at the end of this study a generalization of a statistical nature, but on the other hand, an analytical perspective, once the intention is to use theories identified through various consecrated elements that will serve as a comparative support to the results collected in interviews conducted with executives in organizations in the telecommunications sector, with a focus on network operators.

The selection of organizations belonging to the telecommunications sector, which were the object of this study was based on the guidelines of the initiative of the World Economic Forum (Wef, 2017a) dedicated to exploring and expand the potential of digital transformation in different sectors: retail, automotive, logistics, energy, telecommunications, aviation, oil & gas, media, mining, and chemicals. In figure 1, theory emerges from the data collected, which are systematically analyzed, after their registration and comparison.

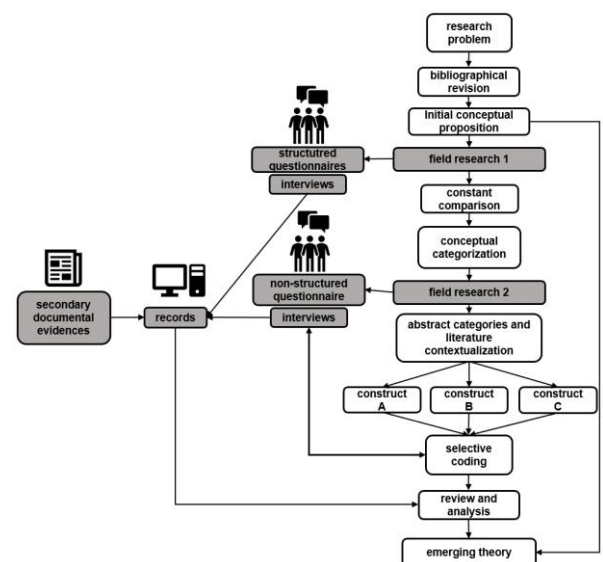


Fig.1: Adapted GTM flowchart integrated with case study

Source: Adapted from Goulding (2002) and Halaweh, Fidler & McRobb (2008)

Seventeen interviewed executives were approached using the following strategy. Upon initial identification from authors contact network, nine of them were pre-qualified based on adherence to strict criteria presented in the theoretical framework. In total eighteen interview sessions were conducted following grounded theory principles. Two executives declined to participate alluding sensitive information could not be shared, totaling seven executives that fit into research study objectives.

III. RESULTS

The proposed framework, which integrates the use of scenarios into the processes of evaluating and selecting projects, was obtained from the collection of field data and its intersection with studied concepts. During the use of grounded theory method based on iterations throughout data collected, the initial conceptual framework had macro concepts developed throughout the literature review. This initial conceptual framework evolved, along the study allowing the resulted framework to emerge from the collection and analysis of data and could be portrayed in figure 2. Conceived framework elucidates the interrelationships between the thirteen constructs identified during the interviews in such a way that it is possible to notice how the construction of scenarios, centerpiece of this study, is derived from these elements. It is possible to notice that the decision-making process in ICTs (ICTD) and the environment scenarios (ESCN) are central and are influenced directly or indirectly by others related to technological trends (TTND), building blocks of digital transformation (DTBB), innovative strategies (INST) and typology of business models (BMTP). The dilemma of business models and servitization (BMDS) represents the main barrier to the design of projects related to more disruptive changes in the current business model (IFPT). Supported by the vision of the experts (VEXP) and the project, program, and portfolio management information

systems (PPMS), the project management office (PMOT) has an important role in the framework as it aggregates a specific organizational structure that can support desired degree of business transformation (DGBT). From the transformation brought about by the digital capabilities created, it is possible to perceive the generation of value through ICTs (VICT).

Aspects that could not be correctly mapped and identified during the collection and analysis were refuted by research team. Refinements and detailing of the product of this research were conducted during the analysis of collected data under the light of grounded theory method, considering required degree of abstraction used to facilitate the manipulation of key concepts, evaluated by criteria such as: credibility (how the research was conducted), transferability (possible generalization), reliability (systematic, documentable, and traceable) and finally, its conformability (extraction of theory from the data). In a comparative perspective of the three observation groups, research team mapped the tools, techniques, strategies, and processes that were identified along the application of grounded theory method. Table 1 illustrates specific objectives of this study and its relationship with the hypotheses woven (as listed on table 3 under conclusions), connected through the categories, subcategories and selective coding established while processing grounded theory collected data.

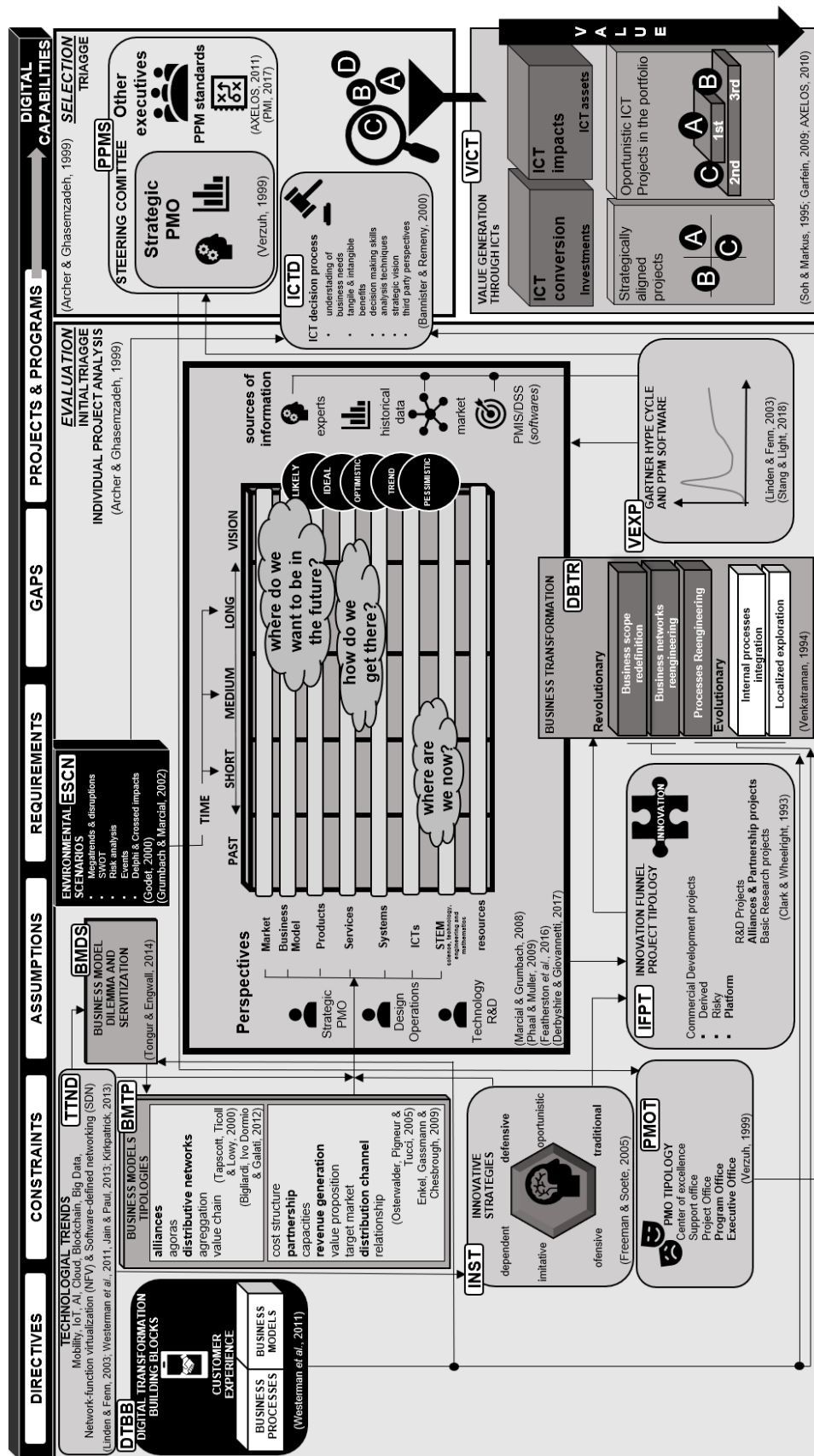


Fig.2: Proposed and validated conceptual framework

Source: the authors

Table 1 – Comparative analysis and identified hypotheses

operator	tools	techniques	strategies	evaluation and selection processes	technologies assessed in the portfolio	identified hypotheses
A1 fixed	Scrum, Design Thinking, Pilot project, PPMS	steering committee, business case, 2 short term scenarios	tactical PMO, focus on business processes, yearly strategic planning cycles, strong matrix organizational structure	final decision investment within a steering committee, reduced portfolio importance	big data and artificial intelligence	H1 and H2
A2 fixed	ideation, voting, PPMS, agile methods	scoring, risk analysis	new organizational structure, Strategic PMO, customer experience focuses and new B2B business models, open innovation	mature portfolio management, governance processes well established	big data, mobility, IoT and cloud computing	H2
B1 mobile	PPMS, Kanban	project war room, innovation squads	strategic acquisitions, focus on new business models, strategic PMO at VP level, open innovation	conflicting interests: corporate PMO x agile processes	big data, artificial intelligence, BI and apps	H2
B2 mobile	PPMS, ideation,	brainstorming and Delphi techniques for creation of 3 future scenarios	strategic PMO, projectized organizational structure, external consultancy support, HQ guidance and partnerships	stringent portfolio governance, project rankings	big data, IoT, cloud computing, virtual reality, and artificial intelligence	H3
C1 multimedia	proof of concept, pilot project, PPMS	scenario generation supported by 3rd party experts	strategic and tactical PMOs, projectized organizational structure, innovation centers (R&D), strategic acquisitions with emphasis on new business models and customer experience, open innovation (hackathons)	stringent portfolio governance, quarterly portfolio reviews influenced by scenarios	software defining network (SDN), network function virtualization NFV), IoT, computing, and artificial intelligence	H3
C2 multimedia	business case, partnerships for project development	meetings, brainstorming	new product development, intermediate scenarios x project scope changes, inexistent PMO	final decision investment within a steering committee, small portfolio, low maturity in project management	cloud computing, IoT	H1
C3 multimedia	partnerships, pilot project, PPMS	meetings	inexistent PMO, product launched on multiplatform strategy	low maturity in project management, main executive with nearly total decision power	software defining network (SDN), network function virtualization NFV), cloud computing	H1

Source: the authors

IV. DISCUSSION

ICTs and business value

For the correct understanding of the term ICTs - information and communication technologies, it is vital to consider its inherent potential to add value to the business and organizations. Considering long term, it is about equipping the organization through digital transformation, with capability to generate a flow of ICT projects that generate value (Soh & Markus, 1995; It Governance Institute, 2008; Garfein, 2009; Hess, 2016). From the perspective of Kane et al. (2015) the strategic flow of value presented in figure 3 is related to a persistent management effectiveness or the balance of costs and benefits (Axelos, 2010) as it results in the satisfaction of needs when generating benefits for the business with the optimized use of the resources employed.

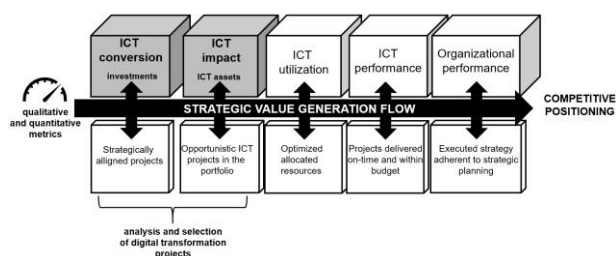


Fig.3: Value generation for business through ICTs

Source: Adapted from Soh & Markus (1995, p.37), Garfein (2009, p.51) and Axelos (2010, p.39)

Although there is a rapid assimilation of ICTs in different sectors to a higher or reduced degree, it is necessary to clearly establish how it can initially change business processes (often automating something that was previously done manually) and at a more advanced stages, these technologies can enable new and disruptive business models. Venkatraman (1994) called these stages evolutionary and revolutionary in the measure of its ability to innovate at five levels aiming at the transformation of the business. In the same perspective, new studies of innovation theory with focus on servitization pointed to strategies that creates value through innovations in the value proposition offered to customers, which in the perspective of Barnett et al. (2013), starts to drain more investments than typical research and development purely of a technological nature.

Digital transformation and innovation

The term digital transformation, as a phenomenon begins to appear in scientific articles and specialized literature from the seminal definition of

Andal-Ancion, Cartwright & Yip (2003) in which they interpret it from its different mechanisms for the disintermediation, remediation, and mediation of interorganizational interactions based on ICTs, back then still referred to as NIT - new information technologies. These were also followed by studies conducted by Stolterman & Fors (2004, p.689), when positioning it as a set of “changes that digital technology causes or influences in all aspects of human life” that, due to their ubiquity, lead society to a world increasingly immersed in technology.

Another vision of digital transformation has been propagated, mostly by German-speaking countries, under the term Industry 4.0. For the purposes of this study and in line with Herman, Pentek & Otto (2016) and corroborated by de Azevedo (2017) in their thesis, this is the same phenomenon. In short, the digital transformation paradigm can be better understood with reference to its building blocks, as shown in figure 4. In highlight, the areas where digital transformation projects will be considered for the purposes of this study: business processes and business models that creates essential digital capabilities.

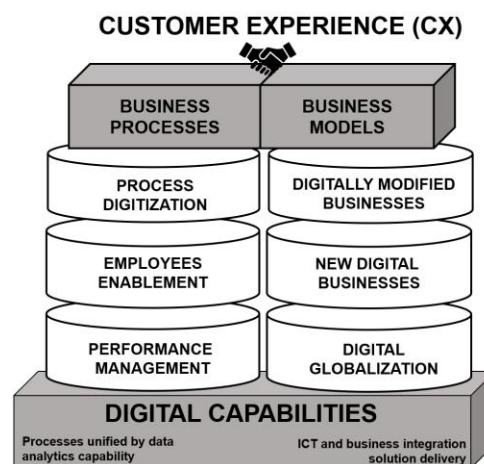


Fig.4: Digital transformation blocks.

Source: Adapted from Westerman et al. (2011, p.17)

ICT investment decision

Independently of its magnitude, ICTs investments must always happen in 3 different spheres, but intimately interrelated and known essentially for hardware, software, and people, as taught by Turban et al. (2010). However, it is not uncommon the expected benefits of ICTs to find as a limiting factor precisely the low adaptation of individuals to the innovations introduced by ICTs (Markus, 1983; Kalakota & Robinson, 1999; Laar et al., 2017). Correia Neto & Leite (2015) argue that despite investments in ICTs have

similarities with any other investment made in organizations, it brings aspects that are consistent with the investment decision model from the perspective of Bannister & Remenyi (2000) and illustrated in the figure 5 that guides some aspects of this study:

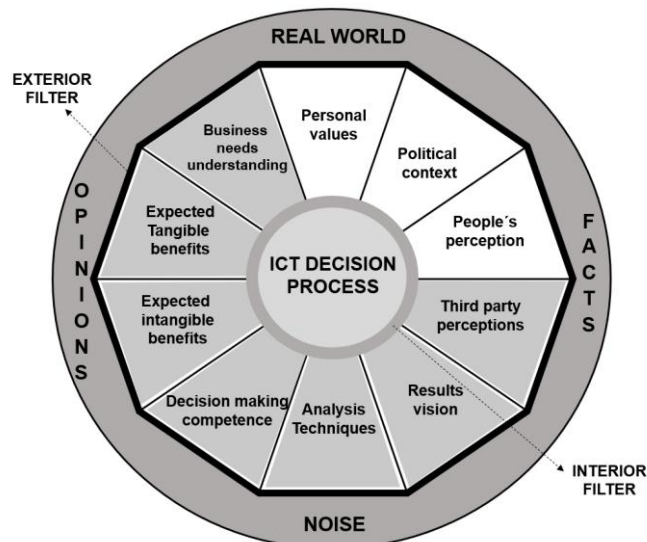


Fig.5: ICT decision process model.

Source: Adapted from Bannister & Remenyi (2000, p. 237)

In order to focus on the decision to invest in ICTs, taking as a parameter the decision analysis of their investment projects, this study will contemplate the gray regions of figure 5, which configure the most preponderant factors for such analysis (Venkatraman & Henderson, 1993; Soh & Markus, 1995; Bannister & Remenyi 2000).

ICTs and new business models.

At higher maturity stages in the use of ICTs, organizations obtain results that can reconfigure not only their business processes, but also create business models with value and scope proposals that are conceptually different from their original businesses (Venkatraman, 1994; Andal- Ancion, Cartwright & Yip, 2003; Osterwalder, Pigneur & Tucci, 2005; Chesbrough, 2010; Teece, 2010). However, as new business model projects bring with them a high degree of innovation and risk, they need to be addressed in multiple perspectives. It is known that for most organizations, rethinking their business model while repositioning themselves in the face of intense technological change such as digital transformation can be understood within what Christensen (2013) and Tongur & Engwall (2014) call business model dilemma.

Venkatraman, Henderson & Oldach (1993) proposed that business strategy provides clarification within the strategic fit model, which have a multiple cross-impact. Years later, these aspects were revisited and endorsed with the model conceived by Earl (1995). This fact reinforced the perspective of strategic choices, naming them as: business strategy, information technology strategy, organizational structure & processes and, finally, information technology infrastructure and processes.

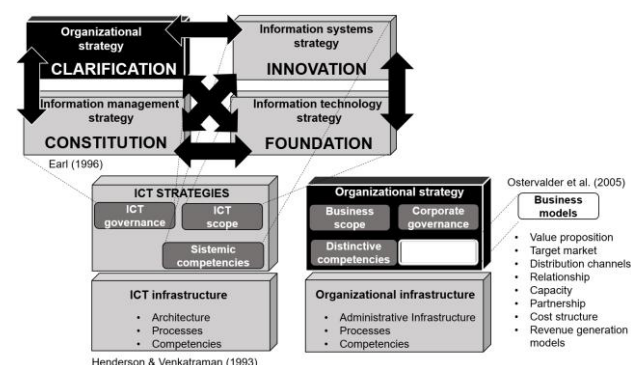


Fig.6: ICT and business models interactions

Source: Adapted from Earl (1995, p. 495), Henderson & Venkatraman (1993, p. 476) and Osterwalder, Pigneur & Tucci (2005, p.29)

Management of ICT portfolios and projects

Portfolio management from the point of view of investment diversification and consequent dilution of its inherent risks, seek to optimize the effectiveness of investments in new products, new processes, and even new business models (Osterwalder, Pigneur & Tucci, 2005). In the specific case of programs that aim is to digitally transform such organization, where this becomes especially important, once these transformational or strategic programs often include several component projects and continuous operations as taught by Archibald & Archibald (2016). Thus, the relationship between the business strategy and its interactions with the three layers of project portfolio management (project, program, and portfolio) are evident.

One of the strategies frequently adopted by organizations that need to manage increasingly complex projects distributed among its business areas, the resulting programs and their structuring portfolios also appear in the form of an organizational innovations (Hobbs, Aubry & Thuillier, 2008; Aubry et al., 2010; Drei & Silva, 2019). In this sense, project management offices known as PMO, have received special attention from organizations that recognize their maturity in the way they manage their projects, programs and portfolios may

depend on an organizational structure that offers guidance, standardization, and governance at these three management layers. Amongst numerous PMO functions is an economic-financial approach, using various techniques such as NPV - net present value, EVA - added economic value (Chen & Dodd, 1997), IRR - internal rate of return, discounted payback, where its first step is to scrutinize project in terms of its expenditures and revenues, in order to subsequently discount cash flows at present value, even if the technique is combined with the use of real options (Facó, 2017; Paiva, 2017) that also seek to value the decision to invest or delay project (Amram & Kulatilaka, 1999; Trigeorgis & Smit, 2004).

It is also clear that, even if the project is approved and initiated, it must undergo successive scrutiny at each phase closure, where an analysis of its performance indicators is normally conducted. If the project is not able to generate the expected results and benefits (including ones related to tax relief), it may cede its place and resources undertaken to other initiatives that will compose a refreshed portfolio (Archer & Ghasemzadeh, 1999; Cooper, Edgett & Kleinschmidt, 2001; Itikawa & Santiago, 2021). Archer & Ghasemzadeh (1999) proposed a model represented in figure 7 that aims at selecting project portfolios, where the individual analysis of projects is shown.

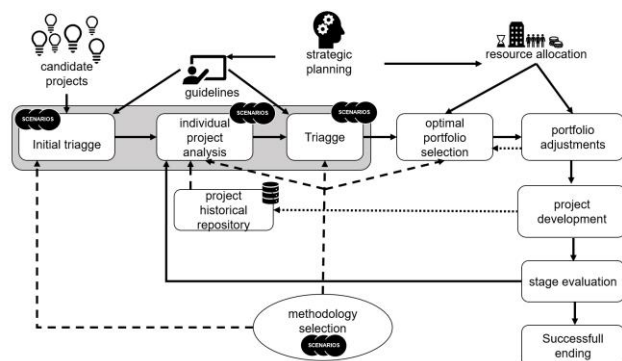


Fig.7: Project portfolio selection model

Source: Adapted from Archer & Ghasemzadeh (1999).

Business decision using scenarios

According to Chermack, Lynham & Ruona (2001) when searching for the roots of planning facilitated by scenarios, it became evident as well as several other techniques and scientific discoveries, that the term was coined in the military environment as early as the 1940s, where the former RAND Corporation, engaged in the development of armaments with great use of R&D and technology, where such term was conceived as future-now. From this point onwards, the interest of corporations increased dramatically during following years, in the face

of the success obtained by Royal Dutch Shell's executive and its understanding created by Schwartz (1996). Obviously, there are innumerable views regarding the use of scenarios for strategic planning purposes, among which Porter (1986) refers to it as "partial views, internally consistent of what the world will be in the future and that can be chosen to limit the set of circumstances that may occur". Such scenarios can be subdivided into three categories (feasible, probable, and desirable) according to Santos (2011).

Figure 8 shows the application of the environment scenario technique directly to prospective technological trajectories as recommended by Phaal & Muller (2009). The Grumbach scenario method also allows participation of experts quite common in the field of ICTs during the creative process and it is supported by specific software able to handle Bayesian networks to generate scenarios and probabilities.

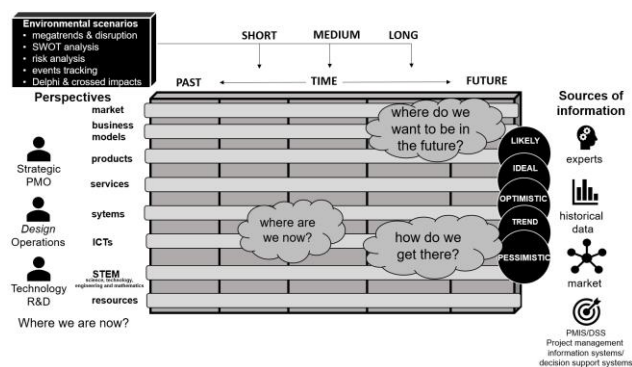


Fig.8: Environment scenarios and technological trajectory

Source: Adapted from Grumbach & Marcial (2008, p. 106),

Phaal & Muller (2009, p.40), and Santos (2011)

Proposition of a conceptual structure (framework)

The selection of operators was made based on the licenses issued by Brazilian regulatory agency, Anatel - national telecommunications agency, made until the first half of 2017. In table 2 it is possible to identify the characterization of the sampled operators as well as the interviewees, separated by observation group. For confidentiality and privacy reasons, each of the executives interviewed was assigned a number and the participating operators a letter followed by a number that associates it with the observation group to which it belongs. The proposed questions dealt with articulation of scenarios to understand the impact of emerging technologies for telecom sector, seeking to identify techniques, procedures, software, and methodologies used by decision makers in their quest for optimal decision

concerning digital transformation project portfolio. Thus, through these combined questions, it was also possible to identify in some cases the type of innovative strategies adopted by operators as per typology proposed by Freeman & Soete (2008).

Comparative analysis of observation groups

The first observable aspect is the centrality of the studied phenomenon centered on actions or observations of the interviewed executives whose statements were identified. The second aspect, which is equally important, is the context in which the studied phenomenon unfolds, which suggests that action and interaction strategies are taken. There may also be intervening conditions that limit or enable the action strategies defined in the context that can be individualized. And finally, the consequences are a product of the strategies selected by the observed organizations, in this case, the operators subdivided into their three observation groups (Golafshani, 2003; Halaweh, Fidler & Mcrobb, 2008).

In observation group A, of the fixed operators, there was a lower degree of integration of scenarios into the evaluation and selection process, while in group B, this element appears more present throughout the stages of the process. Paradoxically, in the case of observation group A, of fixed operators, scenarios were cited by executives 1 and 2 at a slightly higher level in comparison to observation group B (mobile), however, it was not possible to detect additional evidence in the tooling, processes and techniques that prove effective integration of scenarios in the evaluation and selection of projects in the ICT portfolios. Another interesting finding was that there was a strong concern with the digitization of processes, articulating artificial intelligence and big data tools, followed by several projects and programs to improve customer experience. Mentions to reposition current business model were also present, which may suggest that these operators are more concerned with their revenue generation capacity, especially when compared to observation group B (mobile) in which this concern was less latent.

Observation group B, of mobile operators, was the group with the highest number of projects dedicated to

digital transformation and, therefore, where it was possible to identify a greater degree of integration of scenarios into the decision-making process with a great preponderance of the strategic PMO positioned in higher hierarchical levels. Executive 4 from operator B2 indicated that scenario generation process, given the mix of technologies contained in the portfolio, can reach up to 3 future scenarios. Although in this observation group, questions about new business models have emerged, only one of the executives indicated a high concern of the organization with the business model aspect, with 60% of the projects contributing to specific objectives related to partnerships.

It was possible to verify that, amongst three observation groups, group C of the multimedia operators was the most heterogeneous of them and one of the reasons for this fact, lies in the aspect that the operators of this group, besides acting in different niches (global networks and carrier operators) also had quite different sizes. On the other hand, according to the analysis of the data collected, in comparison with the other observation groups (A, fixed and B, mobile), executives of these operators were more affected by technological trends than the others, especially the C1 executive belonging to a global scale operation. In comparison with the other groups, this one demonstrated in the narratives, a high concern with future business models. One of the possible components that may have contributed to this perception would be linked to a greater dependence on organizational assets with a high risk of commoditization (physical networks), especially in the category known as operators of operators, which, unlike operator C3, have more developed digital capabilities in managed services via platforms that can be considered agnostic.

In the three observation groups, it was possible to identify pieces of digital marketing communicated to the market and shareholders, and participation in market events involving digital transformation efforts and discussions. In these secondary evidences, properly collected over the 14-month interval, it was possible to identify elements that emerged during the interviews, which allowed confirmation or any inconsistency of aspects brought by the executives interviewed.

Table 2 – Characterization of interviewed executives and operators.

observation group	interviewed executive / expertise in years	operator	products & services	size & market	portfolio nature	portfolio profile	position & function
A fixed	1	A1	retail: voice (fixed and mobile), broadband, PayTV corporate: voice, broadband, value added services, cloud solutions operators: connectivity	large, national	focusing on business processes (80%) aiming cost reductions, operational costs optimization and customer experience (20%).	50 projects, 1 program	Senior Manager, PMO, corporate
	2	A2	retail: voice (fixed and mobile), broadband, PayTV corporate: voice, broadband, value added services, cloud solutions operators: connectivity	medium, regional	strong focus on business processes and repositioning of B2B business models	60 projects grouped in 3 programs, one of them connected to cultural aspects of agile teams	Governance and Strategy Manager, PMO corporate
B mobile	3	B1	retail: voice (fixed and mobile), broadband, PayTV corporate: voice, broadband, value added services, cloud solutions operators: connectivity	large, International	main focus on business processes and customer experience (90%) with few evidences of projects dealing with business models	70 projects, 2 programs	Senior Manager, PMO corporate
	4	B2	retail: voice (fixed and mobile), broadband, PayTV corporate: voice, broadband, value added services, cloud solutions operators: connectivity and equipment	large, international	business processes (40%) business models (60%), including partnerships and alliances	100 projects, 4 programs	Chief Operations Officer - COO, PMO corporate
C multimedia	5	C1	corporate: managed solutions (voice/data/video) with embedded security and connectivity operators: connectivity, IP traffic	large, international	digitized products and services (40%) customer experience (30%) business models (30%)	130 projects, 6 programs	Latin America Director, Business unit

6	C2	corporate: connectivity, advanced voice IP solutions and cloud operators: conectivity	small, regional	new products and services development (100%)	3 small projects	Chief Technology Officer - CTO, Top level executive
23 years 20 in PPM						
7	C3	corporate: connectivity, operators: connectivity for remote and difficult locations (last mile)	medium, regional, operator of network operators	new multiplatform products and digitized processes	20 small projects and 10 large projects	Chief Executive Officer - CEO, Top level executive
25 years 18 in PPM						

Source: the authors

V. CONCLUSION

This study aimed to analyze the use of scenarios during the evaluation and selection of innovation projects with a specific focus on digital transformation, structured in portfolios of projects and programs, as well as determining

how they influence the trajectory of telecommunications operators towards the desired state. The following aspects were established as specific objectives that sought to validate or refute the hypotheses constructed according to table 3:

Table 3 – Specific objectives and hypotheses

specific objectives	hypothesis		
	H1	H2	H3
identify tools, techniques, strategies, and processes utilized by organizations to determine technologies that will evolve into a dominant design.	researched organizations do not have at current stage of technology use, enough maturity to elaborate prospective scenarios to understand how digital transformation will affect their businesses;	researched organizations although recognize opportunities and threats brought by digital transformation, they can't articulate a vision of future based on scenarios so they can interfere on portfolio management and guide its efforts. Digitally transformed organization under such hypothesis requires several intermediate transformational stages;	researched organizations seek effective ways to deal with future scenarios for digital transformation, even that still need external support (consultants) to achieve an optimal selection of projects within its digital transformation project portfolio;
analyze utilization of different scenarios for each technological alternative and understand how They affect desired state after project selection.			

Source: the authors

A sample of seven operators is representative, within established initial objectives for a exploratory and qualitative research, draws a panorama that may not represent in its entirety the reality of other organizations that could have been included in the study. On the other

hand, in the case of fixed and mobile operators, where there is a high market concentration in Brazil, this aspect becomes less relevant for the reasons clarified by Halaweh, Fidler and McRobb (2008) where they maintain that integrating case study with grounded theory can be

considered satisfactory with the number of cases between 4 and 10. In the case of multimedia operators, due to their heterogeneity, an additional amount of researched organizations could contribute in order to correct asymmetries that could not be detected in the present study.

The tooling for articulation of scenarios proved to be more present in mature organizations from both project management and formal strategic planning perspectives. Thus, the proposed conceptual framework would lead to a more practical adaptation, aiming at its applicability by some of the executives of small operators, especially those called mirrors and operator of operators.

In relation to the second specific objective, which was to identify the use of different scenarios dedicated to exploring technological alternatives, it was possible to verify that only operators B2 (mobile) and C1 (multimedia), both of large size and international presence, clearly were influenced by articulated scenarios in their trajectories. In both cases, the operators worked with mechanisms to generate three or more scenarios with the help of external consultants. These were the two operators within the sample that showed adherence to hypothesis H3. Despite the size and the high revenue level, operator A1 demonstrated low integration of scenarios into strategic planning, especially in the stages of project evaluation and selection. In this same group, adhering to hypothesis H1, there were operators A1 (fixed), C2 and C3 (multimedia). In contrast, operators A1 and A2 (fixed) and B1 (mobile) showed adherence to hypothesis H2 due to the fact they utilize short-term scenarios, compatible techniques and tools for mapping risks, and ranking projects prior to their evaluation and selection.

REFERENCES

- [1] Andal-Ancion, A., Cartwright, P. A., & Yip, G. S. (2003). The digital transformation of traditional business. MIT Sloan Management Review, 44(4), 34.
- [2] Amram, M., & Kulatilaka, N. (1999). Disciplined decisions. Harvard Business Review, 77(1), 95-96.
- [3] Archibald, R. D., & Archibald, S. (2016). Leading and Managing Innovation: What Every Executive Team Must Know about Project, Program, and Portfolio Management. CRC Press.
- [4] Archer, N. P., & Ghasemzadeh, F. (1999). An integrated framework for project portfolio selection. International Journal of Project Management, 17(4), 207-216.
- [5] Aubry, M., Müller, R., Hobbs, B., & Blomquist, T. (2010). Project management offices in transition. International Journal of Project Management, 28(8), 766-778.
- [6] Axelos (2010). Management of Value (MoV). London, England: TSO.
- [7] Bannister, F., & Remenyi, D. (2000). Acts of faith: instinct, value, and IT investment decisions. Journal of information Technology, 15(3), 231-241.
- [8] Barnett, N., Parry, G., Saad, M., Newnes, L., & Goh, Y. M. (2013). Servitization-Complex engineering service availability: Is a paradigm shift in the business model and service enterprise required?. Strategic Change: Briefings in Entrepreneurial Finance, 22(3-4), 145-156.
- [9] Charmaz, K. (1996). The search for Meanings–Grounded Theory. In. Smith JA, Harre R., & Van Langenhove L. (Eds.), Rethinking Methods in Psychology (pp. 27–49).
- [10] Chen, S., & Dodd, J. L. (1997). Economic value added (EVA™): An empirical examination of a new corporate performance measure. Journal of managerial Issues, 318-333.
- [11] Chermack, T. J., Lynham, S. A., & Ruona, W. E. (2001). A review of scenario planning literature. Futures Research Quarterly, 17(2), 7-32.
- [12] Chesbrough, H. (2004). Managing open innovation. Research-Technology Management, 47(1), 23-26.
- [13] Chesbrough, H. (2010). Business model innovation: opportunities and barriers. Long range planning, 43(2-3), 354-363.
- [14] Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (1999). New product portfolio management: practices and performance. Journal of Product Innovation Management: An International Publication of The Product Development & Management Association, 16(4), 333-351.
- [15] Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. Qualitative sociology, 13(1), 3-21.
- [16] Corbin, J. M., & Strauss, A. (2001) Portfolio Management for New Product Development: Results of an industries practices study. R&D Management, Vol. 31, nº 4.
- [17] Correia Neto, J. F., Leite, J. C. (2015) Decisões de Investimento de Tecnologia da Informação: vencendo os desafios da avaliação de projetos em TI. 1ª ed. Rio de Janeiro, Elsevier.
- [18] Christensen, C. M. (2013). The innovator's dilemma: when new technologies cause great firms to fail. Harvard Business Review Press.
- [19] de Azevedo, M. T. (2017). Transformação Digital na Indústria: Indústria 4.0 e a Rede de Água Inteligente no Brasil. Novas Edições Acadêmicas.
- [20] Dosi, G. (1983). Technological paradigms and technological trajectories. Research Policy, 11(3).
- [21] Drei, S. M., Silva, T. A. O. (2019). A multi-criteria approach to the problem of managing the new product development project portfolio. International journal of advanced engineering research and science.
- [22] Santos, Marcos Olímpio Gomes dos (2011). texto de apoio sobre o método dos cenários – Compilações. Évora, jul.
- [23] Earl, M. J. (1995). Integrating IS and the organization: a framework of organizational fit. London Business School.
- [24] Facó, J. F. B. (2017). VALE A PENA INVESTIR: Finanças e Inovação em uma Análise Interdisciplinar da

- Aplicação da Teoria de Opções Reais em um Cenário Incerto de Tríplice Epidemia. Simplissimo Livros Ltda.
- [25] Freeman, C., & Soete, L. (2008). A economia da inovação industrial. Editora da UNICAMP.
- [26] Garfein, S. J., & Chairman, R. P. M. (2009). Expanding Strategic Throughput: A New Perspective on Closing the Gap between Strategy and Results. Project Management Institute.
- [27] Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The qualitative report*, 8(4), 597-607.
- [28] Goulding, C. (2002). *Grounded theory: A practical guide for management, business, and market researchers*. Sage.
- [29] Marcial, E. C., & Grumbach, R. D. S. (2008). Cenários prospectivos: como construir um futuro melhor. rev. ampl. Rio de Janeiro: Editora FGV.
- [30] Halaweh, M., Fidler, C., & McRobb, S. (2008). Integrating the grounded theory method and case study research methodology within is research: A possible 'road map'. *ICIS 2008 proceedings*, 165.
- [31] Hermann, M., Pentek, T., & Otto, B. (2016, January). Design principles for industrie 4.0 scenarios. In *2016 49th Hawaii international conference on system sciences (HICSS)* (pp. 3928-3937). IEEE.
- [32] Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive*, 15(2).
- [33] Hobbs, B., & Aubry, M. (2007). A multi-phase research program investigating project management offices (PMOs): the results of phase 1. *Project Management Journal*, 38(1), 74-86.
- [34] IT Governance Institute. (2008). *Enterprise Value: Governance of IT Investments, the Val IT Framework, Version 2.0*. ISACA.
- [35] Itikawa, M., Santiago, S. B. (2021). A Systematic Review on Industry 4.0 Maturity Metrics in the Manaus Free Trade Zone. *International journal of advanced engineering research and science*.
- [36] Kalakota, R., & Robinson, M. (1999). *E-business: Roadmap for success*. addison-Wesley. Reading, MA.
- [37] Van Laar, E., Van Deursen, A. J., Van Dijk, J. A., & De Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in human behavior*, 72, 577-588.
- [38] Markus, M. L. (1983). Power, politics, and MIS implementation. *Communications of the ACM*, 26(6), 430-444.
- [39] Meissner, P., & Wulf, T. (2013). Cognitive benefits of scenario planning: Its impact on biases and decision quality. *Technological Forecasting and Social Change*, 80(4), 801-814.
- [40] Nelson, R. R., & Winter, S. G. (1977). In search of a useful theory of innovation. In *Innovation, economic change, and technology policies* (pp. 215-245). Birkhäuser, Basel.
- [41] Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. *Communications of the association for Information Systems*, 16(1), 1.
- [42] Paiva, F. A., Jorge, R. R., de Andrade, A. A., Junger, A. P., & Facó, J. F. B. (2017). Utilização Da Teoria Das Opções Reais Em Estudo De Caso Para Avaliação De Troca De Ponto De Venda Para Loja De Varejo Em Shopping Center. *Revista de Casos e Consultoria*, 8(4), e841-e841.
- [43] Phaal, R., & Muller, G. (2009). An architectural framework for roadmapping: Towards visual strategy. *Technological forecasting and social change*, 76(1), 39-49.
- [44] Porter, M. E. (1986). *Estratégia Competitiva—Técnicas para análise de indústrias e da concorrência*. 18ª Edição. São Paulo-SP: Campus.
- [45] Project Management Institute. (2016). *Governance of Portfolios, Programs, and Projects*. Pennsylvania: PMI.
- [46] Project Management Institute. (2017). *A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Sixth Edition*. Pennsylvania: PMI.
- [47] Project Management Institute. (2017). *Standard for Portfolio Management – Fourth Edition*. Pennsylvania: PMI.
- [48] Schoemaker, P. J. (1995). Scenario planning: a tool for strategic thinking. *Sloan management review*, 36(2), 25-50.
- [49] Schwab, K. (2017). *The fourth industrial revolution*. Currency.
- [50] Schwartz, P. (2012). *The art of the long view: planning for the future in an uncertain world*. Crown Business.
- [51] Soh, C., & Markus, M. L. (1995). How IT creates business value: a process theory synthesis. *ICIS 1995 Proceedings*, 4.
- [52] Stolterman, E., & Fors, A. C. (2004). Information technology and the good life. In *Information systems research* (pp. 687-692). Springer, Boston, MA.
- [53] Teece, D. J. (2010). Business models, business strategy and innovation. *Long range planning*, 43(2-3), 172-194.
- [54] Tongur, S., & Engwall, M. (2014). The business model dilemma of technology shifts. *Technovation*, 34(9), 525-535.
- [55] Trigeorgis, L., & Smit, H. T (2012). *Strategic investment: Real options and games*. Princeton University Press.
- [56] Turban, E., Leidner, D., Mclean, E., & Wetherbe, J. (2010). *Tecnologia da Informação para Gestão-: Transformando os Negócios na Economia Digital*. Bookman.
- [57] Venkatraman, N., Henderson, J. C., & Oldach, S. (1993). Continuous strategic alignment: Exploiting information technology capabilities for competitive success. *European Management Journal*, 11(2), 139-149.
- [58] Wack, Pierre. (1985) *Scenarios: uncharted waters ahead*. Harvard business review, September-October, p. 73-89.
- [59] WEF – World Economic Forum. (2017) *Unlocking Digital Value to Society: A new framework or growth*. Genève: WEF
- [60] WEF – World Economic Forum. (2017) *Digital Transformation Initiative – Telecommunications Industry*. Genève: WEF.