

# Communication Channels in Brazilian Software Projects: An Analysis based on Case Study

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Abstract: Technology project management is challenging. However, there are few works in the literature related to communication channels (CC) and project success. Therefore, this research aims to analyze the influence of communication channels on the short and medium-term success of software development projects in a Brazilian enterprise. This research is based on a literature review about communication channels and project success. The research has a qualitative and descriptive approach and used an ex-post-facto strategy. Ten software development project management professionals were interviewed at a large banking institution in the first half of 2019. This research confirmed a positive association between CC and software project success when considering efficiency, impact to the customer, and project staff. Besides, we also identified the two most relevant CC for the context studied and identified a CC not mentioned in the literature.

## 1 INTRODUCTION

There is a perception among specialists that information technology projects fail regularly. Only 36% of software projects are completed on time and on-budget (Standish Group, 2015). Even worst, when considering different points of view from researchers, practitioners, and academics perspectives (Al-Ahmad *et al.*, 2009) there is still no single measure of software project success (Shenhar & Dvir, 2007). Even when a project is considered well-done, there are still many reports of challenges and efforts to overcome them (Al-Ahmad *et al.*, 2009).

Most of the project issues are related to the human aspects: behavioral, organizational, or managerial aspects (Hartman & Ashrafi, 2002). Embracing all these aspects, the communication process is accountable for many issues, including both its inputs and outputs (Lu, Liu, & Liu, 2009), including the communication channels (CC).


Another research gap is that project data relating to communication is not usually collected and analysed in parallel with the project execution. These research approaches gap to capture the project


*momentum* data, such as CC data. Instead of that approach, it is suggested to collect and analyze data when the project is still going on or, if not possible, at least when the project has just been finished (Shenhar & Dvir, 2007; Lu, Liu, & Liu, 2009).


Even further, we performed a research and discovered a gap that related communication and software project success: there were only 11 papers in IEEE Xplore and ACM databases relating these two factors from 2010 to 2019. These researches were not related to any developing country.

Given these gaps relating communication and the project success, this research aims to answer the following research question: What are the contributions of CC on the success of software development projects in a Brazilian enterprise?

The research goal is to analyse the influence of CC on software development projects from both short and medium terms perspectives. We aim to analyse this goal through data gathered during project development regarding three criteria: (1) project efficiency; (2) impact to customer; and (3) impact to team members. The research framework was developed in the second semester of 2019.

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## 2 LITERATURE REVIEW

### 2.1 Software Project Success

Project success might be defined as the project has achieved its objectives and its benefits for the organization (Shenhar & Dvir, 2007). This definition sets at least three dimensions: cost, time, and scope dimensions (Dvir, Raz & Shenhar, 2003). These dimensions are also known as the triple constraint, given they consider the project planning objectives. We choose a multidimensional model to accommodate both project success and user/business perspectives. This model endorses five dimensions (Shenhar & Dvir, 2007) as follows:

(1) **Project Efficiency:** the short-term measure that addresses if the project was completed as planned, especially schedule and budget aspects.

(2) **Customer Impact:** the importance of customer requirements.

(3) **Team Members/Staff Impact:** satisfaction, retention, and personal growth of team members.

(4) **Business/Direct Success Impact:** the direct impact the project has on the organization.

(5) **Future Impact:** the medium-term measure that addresses the organization's readiness for future projects.

### 2.2 Project Communication

Communication is an essential element of Project Management (PM) given it ensures the successful delivery of the project (Emmitt & Gorse, 2003). Communication has seven elements as follows: senders, encoding, the message itself, a transmission channel, decoding, receivers, and feedback (Zulch, 2014).

Moreover, when analyzing the communication process, it is important to consider their main characteristics. Table 1 shows the four characteristics most cited in the literature.

Table 1: Project communication characteristics.

Characteristics	Citations
Degree of formality	18
Channels	17
Verbalization	10
Internalization	8
Thirteen other characteristics	25
<b>Total</b>	<b>78</b>

According to Djajalaksana, Zekavat, and Moon (2017), these four characteristics could be defined as:

(1) **Degree of Formality.** There are two types of communication formality: formal communication, which is structured and officially enforced by the management; and informal communication, which is unstructured and made by the team members to address deficiencies and minimize insecurity of the formal communication system.

(2) **Verbalization.** Verbal communication occurs through written, oral, heard, or spoken communication; non-verbal communication refers to paralinguistic communication or carried out through expressions, emotions, or feelings.

(3) **Internalization.** Communication can be internal when it occurs between members of the project or the organization, or external when directed to the client, investors, media, or other stakeholders.

An important feature of communication is its CC. Thus, we describe the CC in more detail below.

### 2.3 Communication Channels

Project communication can be done through CC. Each of them has advantages and disadvantages in their use. According to Gillard and Johansen (2004), the decision of the appropriate CC to be used – telephone, videoconference, e-mail, face-to-face conversation or gestures, a table, a graphic – is of paramount importance. The CC affects the impacts the recipient messages. For example, reading a document can have a different impact than listening to the same message on a conference call, due to the inflections of voice and body language observed in a conference call, but absent in a written document. Choosing an appropriate CC can save time in interpreting the message.

Bhalerao and Ingle (2010) studied the CC used between members of the project team and between them and the clients, in each phase of the project. The research result showed that in all phases face-to-face communication between team members prevails. However, concerning communication with customers, both e-mails and face-to-face communication are used. These authors analyzed the following CC: face-to-face, video, e-mail, documents, telephone, and text messages. Chang and Ehrlich (2007) and Johansen and Gillard (2005) showed similar results.

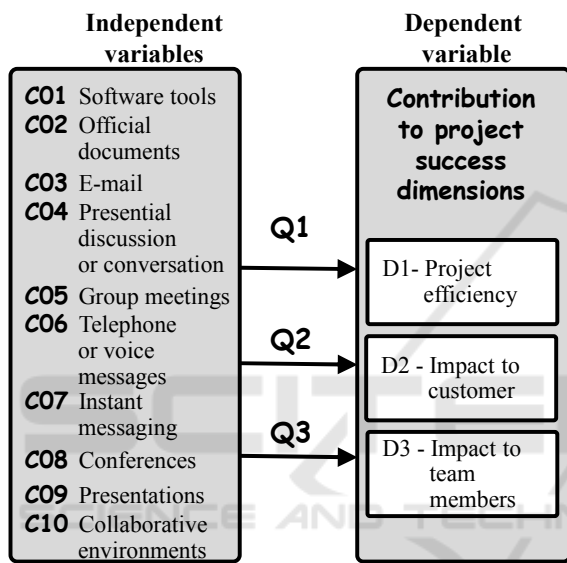
Korkala and Maurer (2014) presented the concept of synchronicity. Synchronicity is defined as the extent to which a CC allows individuals to achieve a shared pattern of coordinated work behavior. Thus, video conferences and face-to-face communication have a high level of synchronicity; conference calls and chats have a medium level; while e-mail, voice

messages, faxes, and documents are low. Hummel and Rosenkranz (2013) present a table containing 23 CC and their respective synchronicity capabilities.

### 3 RESEARCH FRAMEWORK

#### 3.1 Research Variables

The framework is composed of an independent variable and the dependent variable. Figure 1 represents the research framework graphically and these variables are detailed.



\* Q1, Q2, and Q3 are research questions

Figure 1: Research framework.

##### 3.1.1 Independent Variable

The research model has a single independent variable: communication channels (CC). This variable represents the types of CC. Several authors classified the CC in ten types (Chen *et al.*, 2013; Kennedy, McComb & Vozdolska, 2011; Bhalerao & Ingle, 2010; Korkala & Maurer, 2014; Tuomas *et al.*, 2012):

- (C01) Software tools: development suites, source codes, versions, and catalogs tools.
- (C02) Official documents: reports, bulletins, specifications, standardized documents.
- (C03) Electronic mail: e-mail, mailboxes, or distribution lists.
- (C04) Discussion or face-to-face conversation: always involving only two people.
- (C05) Group meetings: always involving more than two people.

- (C06) Telephone/voice messages: messaging applications, answering machine, telephone calls.
- (C07) Instant text messages: applications, corporate programs, communicators.
- (C08) Conferences: audio, video, in person.
- (C09) Presentations: workshops, plenary sessions, lectures.
- (C10) Collaborative informational environments: wikis, forums, web pages.

##### 3.1.2 Dependent Variables

The research framework has three dependent variables based on the success dimensions (Shenhar & Dvir, 2007). These dimensions have negative or positive impacts. Although there are five dimensions of success, only the first three refer to short and medium-term results, which are the scope of this research. The three dimensions used by this research are:

- (1) **Project Efficiency (D1):** measures the contribution to achieving time, cost, and scope goals.
- (2) **Impact on the Customer (D2):** it measures the contribution to meet customer requirements, satisfaction, and loyalty.
- (3) **Impact on Team Members (D3):** it measures the contribution to staff satisfaction, employee retention, and professional growth of team members.

#### 3.2 Guiding Questions

We defined three guiding questions (Q1 to Q3) based on the research main question and based on the literature review (Mark & Wulf, 1999; Aranda *et al.*, 2010; Zulch, 2014; Djajalaksana, Zekavat & Moon, 2017):

- Q1:** Does CC have a positive impact on project efficiency (D1)?
- Q2:** Does CC have a positive impact on customer satisfaction (D2)?
- Q3:** Does CC have a positive impact on team members (D3)?

### 4 RESEARCH METHOD

#### 4.1 Organization Characteristics

The researched company is one of the largest banks in Brazil with international projection. This Bank has a well-defined IT area that is scaffolded by a generous budget. This area has more than two thousand employees working on several technology projects.

These projects serve in all areas, in which there are different sizing and different PM methods. These PM methods are mainly based on waterfall, agile or hybrid approaches.

## 4.2 Participants and Project Criteria

The participants accepted to engage in this research, which represented a unique and highly valuable opportunity for a case study based on (Yin, 2015).

Criteria to select participants were: (1) experience in software development projects within the financial industry; (2) participation in at least three different project phases; (3) education level should include at least bachelor degree; (4) professional experience of at least five years; (5) professionals from several backgrounds, such as software engineers, system developers or project leaders, is important; and (6) at least ten IT professionals as participants.

Criteria to select projects for this case study (Yin, 2015) were: (1) projects must have come from different areas of the organization; (2) projects must have been completed recently or are still in the final stages or the post-implementation phase, to have short/medium term data; (3) projects might have different sizing and (4) projects must have a clear methodology – agile, waterfall or hybrid.

## 4.3 Data Acquisition

We adopted individual interviews as an instrument for data collection due to the qualitative nature of the research (Yin, 2015). The interviews were conducted with ten professionals who participated in different projects related to software development.

We adopted the semi-structured interview (Selltitz, Wrigthman, & Cook, 1987) because it has a pre-establish script that makes it easier to compare information among participants. The first interview was used as a pre-test to guide the other interviews.

Interviews were conducted in the second half of 2019.

## 4.4 Data Processing

Data were processed using two different techniques. First: content analysis, to categorize and interpret the data collected in the interviews. According to Neurendorf (2002), content analysis allows a qualitative exploration of messages and information.

Second: judge analysis. This technique advocates a judgment by a group of experienced experts in the field (Medeiros *et al.*, 2015). The expert group was composed of participants from an individual interview. They analysed the relationship between IC and PS what was done previously one-by-one through individual interviews. A group agreement means: the number of specialists who agree with a statement is at least double of those that do not agree with a statement (Medeiros *et al.*, 2015).

# 5 RESULTS AND DISCUSSION

## 5.1 Sample: The Participants

Ten people were selected for this research. We analysed in the interviews the level of success achieved by the projects and the research questions. Interviews were named from I01 to I10. The first interview served as a pre-test. We selected for the first interview a specialist with more project experience than the other ones to serve as a pre-test.

The questions and the script of the instrument were validated by the pre-test, and the instrument was adjusted to its final version based on these pre-test results. We conducted individual interviews at a quiet and private place in after-hours. The interviews were recorded. We informed all interviewees about the research goals and collect their consent before recording the interview. Table 2 summarizes the interviewees' most relevant characteristics.

Table 2: Participants' sample summary.

Interview	Age	Gender	Schooling	University course	Experience (years)	Interview (minutes)
I01	29	Male	Post-graduated	Information Systems	9	82
I02	25	Male	Post-graduated	Engineering	5	60
I03	26	Female	Post-graduated	Engineering	5	94
I04	28	Male	Bachelor	Computer Science	7	76
I05	28	Female	Post-graduated	Computer Science	6	47
I06	28	Female	Bachelor	Engineering	5	60
I07	31	Male	Post-graduated	Engineering	8	54
I08	29	Male	Post-graduated	Information Systems	9	38
I09	32	Male	Post-graduated	Engineering	5	51
I10	36	Female	Post-graduated	Engineering	18	52
Average	29				7,7	61

Table 3: Projects data sample summary.

ID	Projects areas	Success Achieved	Project Status	Team Members	Approach	Position in company*			Participation in project phases**					
						M	E	S	1	2	3	4	5	6
I01	Pay-out system	Succeed	Finished	175	Agile	•			•	•		•	•	•
I02	Risk analysis	Succeed	Finished	55	Waterfall		•	•		•	•	•	•	•
I03	Technology	Succeed	Running	15	Agile	•				•	•	•		•
I04	Technology	Partially	Finished	10	Hybrid			•		•	•	•	•	•
I05	Risk analysis	Failure	Finished	5	Agile			•		•	•	•	•	•
I06	Technology	Partially	Finished	100	Agile	•					•	•	•	•
I07	Customer relationship	Succeed	Finished	10	Waterfall		•	•	•	•	•	•	•	•
I08	Banking agencies	Succeed	Finished	70	Waterfall		•			•	•	•	•	•
I09	Risk analysis	Succeed	Finished	11	Agile	•			•	•	•	•	•	•
I10	Human resources	Succeed	Finished	40	Hybrid		•		•	•	•			

\* M-manager; E-engineer; S-System analyst

\*\* 1 ideation; 2 requirement definition; 3 software development; 4 test; 5 implantation; 6 post-implantation

### 5.2 Sample: The Projects

We selected ten projects with software development activities in their scope, either in part or in full. These have been started at different points in time between 2016 and 2019. The projects were developed in seven different areas of the Bank: three in the technology area, three in the risk analysis area, and the other ones in four distinct areas.

Nine projects were finished during the field research, which made it possible to identify short or medium terms success criteria. The size of the teams varied but an average was 49 members. The smallest team had five members and the largest one had 175 members. Moreover, participants participated in at least three distinct project phases. All projects achieved full or partial success, except project I05, which was discarded from the sample due to an issue with data. Table 3 summarizes the relation between projects and participants.

### 5.3 Use of Communication Channels

We present to interviewees the list of communication channels identified in the literature. The purpose was for them to rank the most used.

In interview I01, a CC not identified in the literature was reported. The CC is called an “interactive environment” by the organization. It is a CC used in group meetings that have resources for participant interaction. Examples of this interaction are the rooms with walls, tables, and windows that can be used for writing, besides the use of digital panels. This CC is of recent use in the researched organization. We did not find citations about it in the scientific literature; however, it appears in

publications on innovation in organizations (Neves, 2018). This communication channel (C11) was added to the relationship obtained from the literature.

The CC’s frequency of use was assessed using a three-point Likert scale: (1) unused channel; (2) little used channel; and (3) widely used channel. The CC’s frequency of use reported in the interviews is shown in table 4. We use the median statistic to separate the most used from the least used CC. It should be noted that C03 was used in all projects.

### 5.4 Motivation for Use of Communication Channels

One of the objectives of the research was to identify the motivation for the use of a given CC. We analyzed the most used CC, based on the responses collected from the interviewees, which allowed us to classify the motivations in seven categories:

- **Project Life Cycle.** This category includes communications related to backlogs; alignment of activities with project objectives; status and milestones of the project; definitions of technical solutions; and problem-solving.

- **Communication with Stakeholders.** Includes conversations with the customer, users, executives, and leaders. These communications refer to project specifications, follow-up bulletins, status reports, amongst others.

- **Obligation.** Refers to the communication of mandatory project information. Among them, we stand out the use of methodologies, organization internal processes, and project ceremonies.

- **Information Storage.** In software projects, it is necessary to store information related to the versioning and cataloging of the software.

Table 4: Communication channels frequency of use.

Project	Communication channels										
	Most used channels					Less used channels					
	C03	C04	C07	C05	C02	C01	C06	C08	C10	C11	C09
E01	3	3	3	3	3	3	3	2	3	3	3
E02	3	3	2	3	3	3	3	3	1	2	1
E03	3	3	2	2	3	1	1	1	2	1	1
E04	3	3	3	2	2	3	2	1	2	2	1
E05	3	2	3	2	1	3	3	1	1	1	1
E06	3	3	3	3	2	2	1	1	3	3	2
E07	3	3	3	2	3	1	3	3	1	3	2
E08	3	3	3	2	3	2	3	2	1	1	1
E09	3	3	2	3	2	3	2	1	1	1	2
E10	3	3	3	3	3	3	2	3	3	1	2
Frequency	30	29	27	25	25	24	23	18	18	18	16

• **Physical Distance.** Certain CCs are more effective when there is a physical distance between teams.

• **Number of Interactions.** Some motivations are related to CC that handles a lot of messages or contacts well.

• **Broadcast Communication.** In some projects, communication needs are greater or more complex among the project team. Some communications needs are met by group conversations, communication with leaders, informal communication, and conversations in a foreign language. In more complex cases, organizations use war-room communication (broadcast for critical issues).

Figure 2 shows the association between the CC most used and the motivation for its use. Electronic mail (C03), instant text messages (C07), and group meetings (C05) are the three CC with more use motivations. On the other hand, project life cycle and broadcast communication are the two motivations category more often reported.

**C02.** Official documents are also mandatory in internal processes, in addition to being used for status reports.

**C03.** Electronic mail has more motivations: it is used to control activity lists and project backlogs, to send progress reports and reports to clients, to specify and define user requirements, to formalize strategic decisions, to register and storage project decisions, and to other formal communications.

**C04.** Face-to-face conversations took place to discuss problems, define technical solutions, in addition to project members' conversations in a foreign language.

**C05.** The group meetings took place because it was easy for everyone to be in the same physical location and to discuss problems, define the technical

solution, ensure objectives alignment, and control the to-do list of activities. Some meetings took place in the war-room, a place that provides scale communication for critical issues that involve various groups of people. They avoid numerous phone calls and large amounts of text messages.

Motivation	Communication channels					F*
	C03	C07	C05	C04	C02	
Project life cycle	•	•	•	•		4
Broadcast communication	•	•		•		3
Communication with stakeholders	•				•	2
Physical distance		•	•			2
Number of interactions		•	•			2
Obligation					•	1
Information storage	•					1
Frequency	4	4	3	2	2	

\* F- frequency

Figure 2: Motivation to use communication channels.

**C07.** Instant text messages were used for informal group conversations or hierarchical vertical communication. Moreover, they were used to solve doubts and quick points of the projects, define technical issues, and provide communication for teams in different locations.

**C11.** The interactive environment was used predominantly in intrinsic project subjects, such as technical definitions and problem-solving.

### 5.5 Strengths and Weaknesses of Communication Channels

This section addresses the factors that have positively affected the success of projects by each CC. The first analysis focuses on the strengths of the CCs most often used in projects. Table 5 shows the channels' characteristics that enabled the project's success.

Table 5: How Communication channels enabled project success.

CC	Enabling the success of the project through
C02	• Dissemination of the work
C03	• Rapid definition of requirements • Formalization to improve understanding • Speed and agility
C04	• Project alignment and clarification of doubts • Generate discussions, clarify requirements, avoid failures, and send bulk information
C05	• Project alignment and clarification of doubts • Generate discussions, clarify requirements, avoid failures and send bulk information
C07	• Communication tool between members of different physical environments

### 5.6 Communication Channels and Project Success

We perform Table 6 according to the project success dimensions and CC interviews. This table summarizes the results. CC influences short and medium terms success in software development projects under the three dimensions: project efficiency (D1), impact on the customer (D2) and impact on team members (D3). This result is in line with the CC literature (Gillard & Johansen, 2004; Bhalerao & Ingle, 2010; Hummel & Rosenkranz, 2013; Korkala & Maurer, 2014; Kennedy, McComb & Vozdolska, 2011).

Table 6: Communication channels positive contribution over the Project Success.

CC	Success Dimension			Frequency
	D1	D2	D3	
C03	•	•	•	3
C04	•	•	•	3
C05	•	•	•	3
C07	•		•	2
C02		•		1
Frequency	4	4	4	

### 5.7 Research Limitations

This section presents the limitations of the research and its validity. They are mostly related to the data analysis technique and the generalization of the results:

(1) Data analysis technique. The data collected in the interviews were analysed using the content analysis technique. The interpretation of this data was made by the author, which attributes subjectivity to the results.

(2) Results generalization. All participants belong to a single company and constitute a small sample, which does not allow generalization of the research results to other companies, based on 10 people that worked for software development projects.

## 6 CONCLUSIONS

The goal of this paper was to analyse the influence of CC on the software project success from both short and medium terms perspectives within the context of one large Brazilian banking. To achieve this goal, qualitative and descriptive research was carried out using the content analysis technique. This research was carried out with 10 experienced professionals. The answers to the research questions and the contributions of this paper are presented below.

All the research questions had affirmative answers. Thus, it was confirmed a positive association between CC and software project success when considering efficiency, impact to the customer and project staff aspects. This result is in line with the literature which emphasizes the importance of CC in projects.

Furthermore, it was possible to obtain two complementary results. First, a new CC was reported in the projects: the interactive environments. This is a CC related to group meeting environments and conversations that have digital resources for interaction between participants. Examples are rooms with writable walls, glass tables and windows, digital panels, and visual materials. This channel has very recent use in Brazilian enterprises, which may be the reason why we did not find reports about it in the academic literature.

Second, it was possible to analyse the CC. We classified the CC in three criteria: frequency of citation in the literature, motivation for their adoption, and positive contribution to project success. The two most relevant CC for software projects within the analysed context were email (C03) and group

meetings (C05). These two CCs were well classified by the three criteria: they are amongst the most cited in the literature, the ones that have the most motivations for adoption, and the greatest contribution to the success of software development projects.

The contributions of this research allowed the identification of the most effective CC for software development projects in Brazilian companies. Moreover, we identified a new CC (interactive environment – C11) that contributes to project success but has a high cost of implementation. This can be a limiting factor for application in small to medium-sized businesses.

Our project intends to analyze, as future work, the use of digital CC in projects affected by mobility restrictions of project members.

## REFERENCES

- Al-Ahmad, W., Fagih, K., Khanfar, K., Alsamara, K., Abuleil, S., & Abu-Salem, H. 2009. A Taxonomy of an IT Project Failure: Root Causes. *International Management Review*, 5(1), 93-104.
- Aranda, G. N., Vizcaino, A., Palacio, R. R., & Moran, A. L. 2010. What information would you like to know about your co-worker? a case study. 5th IEEE *International Conference on Global Software Engineering* - ISSN 2329-6305. 135-144.
- Bhalerao, S., & Ingle, M. 2010. Analyzing the modes of communication in agile practices. In: *3rd International Conference on Computer Science and Information Technology*, 3, 391-395.
- Chang, K., & Ehrlich, K. 2007. Out of sight but not out of mind? Informal networks, communication, and media use in global software teams. In: *Proceedings of the conference of the center for advanced studies on collaborative research*, pp. 86-97.
- Chen, Q.-L. et al. 2013. A model for project communication medium evaluation and selection. *Concurrent Engineering*, 21(4), 237-251.
- Djajalaksana, M. L., & Zekavat, P. R. & Moon, S. (2017). Effectiveness of on-site communication in residential housing projects. ISARC. *Proceedings of the International Symposium on Automation and Robotics in Construction*, 34, 1-6.
- Dvir, D., Raz, T., & Shenhar, A. (2003). An Empirical Analysis of the Relationship between Project Planning and Project Success. *International Journal of Project Management*, 21, 89-95.
- Emmitt S. and Gorse A.C. 2003. Investigating Interpersonal Communication During Construction Progress Meetings: Challenges and Opportunities. *Engineering, Construction and Architectural Management*, 10(4), 234-244.
- Gillard, S., & Johansen, J. 2004. Project management communication: a systems approach. *Journal of Information Science*, 30(1), 23-29.
- Hartman, F., & Ashrafi, R. 2002. Project management in the information systems and information technologies industries. *Project Management Journal*, 33(3), 5-15.
- Hummel, M., & Rosenkranz, C. 2013. Measuring the impact of communication in agile development: A research model and pilot test. In: *19th Americas Conference on Information Systems*.
- Johansen, J., & Gillard, S. 2005. Information resources project management communication: personal and environmental barriers. *Journal of Information Science*, 31(2), 91-98.
- Kennedy, D. M., McComb, S. A., & Vozdolska, R. R. 2011. An investigation of project complexity's influence on team communication using Monte Carlo simulation. *Journal of Engineering and Technology Management*, 28(3), 109-127.
- Korkala, M., & Maurer, F. 2014. Waste identification as the means for improving communication in globally distributed agile software development. *Journal of Systems and Software*, 95, 122-140.
- Lu, X., Liu, L., & Liu, L. 2009. Relationship research between communication activities and success indexes in small and medium software projects. 1st *International Conference on Information Science and Engineering*, ICISE 2009, IEEE, 5022-5025.
- Mark, G., & Wulf, V. (1999). Changing interpersonal communication through groupware use. *Behaviour & Information Technology*, 18(5), 385-395.
- Medeiros et al., 2015. Modelo de validação de conteúdo de Pasquali nas pesquisas em Enfermagem. *Revista de Enfermagem Referência*, 4, 127-135.
- Neurendorf, K. A. 2002. *The Content Analysis Guidebook*. California: Sage.
- Neves, H. 2018. Por que algumas empresas estão implementando laboratórios de inovação maker internos? Available: <<https://epocanegocios.globo.com/colunas/noticia/2018/05/por-que-algumas-empresas-estao-implementando-laboratorios-de-inovacao-maker-internos.html>>.
- Selltiz, C., Wrightsman, L. S., Cook, S. W. 1987. *Research Methods in Social Relations*. Brazil: EPU.
- Shenhar, A. J., & Dvir, D. 2007. *Reinventing project management: The diamond approach to successful growth and innovation*. Boston: Harvard Business School Press.
- Standish Group. 2015. CHAOS Report. Available at [https://www.standishgroup.com/sample\\_research\\_files/CHAOSReport2015-Final.pdf](https://www.standishgroup.com/sample_research_files/CHAOSReport2015-Final.pdf)
- Tuomas, N. et al. 2012. Reflecting the choice and usage of communication tools in global software development projects with media synchronicity theory. *Journal of Software: Evolution and Process*, 24(6), 677-692, 2012.
- Yin, 2015. *Case Study Research and Applications: Design and Methods*. USA; Sage.
- Zulch B. 2014. Communication: The Foundation of Project Management. *Procedia Technology*.