CASY STUDY

Analysis of project management principles with the Scrum framework in systems development: a case study in a public organization

Jefferson de Souza Pinto[1,2] , Reginaldo da Silva Leme[1]

[1]Federal Institute of São Paulo (IFSP), Bragança Paulista, SP, Brazil.
[1,2]State University of Campinas (Unicamp), Campinas, SP.

ABSTRACT

Objective: Demonstrate a case study on project management using the Scrum framework in the development of systems for a public organization.

Design / Methodology / Approach: The research method used in the Case Study is an exploratory research with a qualitative approach, through data collection, application of a structured questionnaire to Stakeholders, Scrum Master and Product Owner and analysis of the artifacts generated.

Results: The work demonstrated the factors that affect the effectiveness application of the Scrum framework, highlighting bad practices and barriers related to the understanding of business and products, which reduce the ability to deliver quality and value, ineffectiveness of the method application.

Research limitations: the number of interviewees in the organization, for further analysis in the case study.

Originality/Value: while previous studies focus on the application of the Scrum method in private companies, this paper presents a case study from the perspective of a public organization.

Keywords: Project Management; Agile Methods; Scrum; Public Organization.

1 INTRODUCTION

Management applied to the development of Information Systems has been conducted differently from traditional approaches, since technology has a strong probability of unpredictability in defining its scope (LARSON and GRAY, 2016) evidencing the need for a new approach in this scenario.

It should be noted that project management is nothing more than the application of knowledge, skills, tools and techniques to project activities in order to fulfill its requirements (PMI, 2017). However, this management should not be done in any way, for this, Kerzner (2013), reports that most companies recognizes that a project management must be implemented through the use of methodologies, this must be a path to be followed throughout its life cycle, by applying its methods.

In this context, it is observed that the use of Agile Methods (AM) has been advancing in Brazil, as pointed out in a survey carried out by Everis (2020), in partnership with MIT Tech Review, and published in the third edition "Agility in Latin America", which highlights the 30% increase in investment by companies in agile projects since 2017, focusing on improving their transformation processes (INFOCHANNEL, 2020).

Thus, for the application of these MA, there are several frameworks available, however, Kerzner (2020, p. 687), reports that "Scrum is the most known and adopted, having as its premise the pursuit of delivering value as quickly as possible to the customer ". In this regard, Adell (2013) explains that the application of such a framework can provide several benefits for companies, such as saving time and money, due to its iterative nature and speed in creating systems.

Adell (2013) too highlights that Scrum has as characteristics the speed and rapidity in coding and testing a system, due to its short Sprints; holding daily meetings that allow early identification of problems and quick correction; the daily update of the progress of the project that makes it possible to measure the productivity of its members; and continuous feedback from the user, denoting the iterative characteristic of the method in question.

Thus, the general objective of this work was to analyze the principles of agile project management and the use of the Scrum framework in systems projects for a public organization.

2. LITERATURE REVIEW

2.1 Project Management

Originating in the early sixties, Project Management was widely disseminated in 1969, the year in which the Project Management Institute (PMI) was created, which encompassed the best practices for the execution of this management.

Guido (2018) points out that Project Management is nothing more than planning, organizing, coordinating, leading and controlling resources to achieve a set objective.

In this regard, Menezes (2018) also shares that such strategic management has the scope of providing organizations with assets to define their objectives, transforming them into results.

It is worth noting that PMI (2017) highlights the need for measures to be taken that will directly impact the individuals, groups, and organizations involved, so that this will reflect in the achievement of such an objective, thus allowing to provide responses to risks, stakeholder satisfaction, and optimization of organizational resources, among others.

When approaching management applied to the development of Information Systems, Larson and Gray (2016) point out that technology has a peculiar characteristic in this regard, with a strong probability of unpredictability in defining its scope.

In this sense, the search for results must be based on methodologies that are prepared for the scenario in question, focusing on the proposition of delivering value to the client, enabling the achievement of the objective outlined for the project.

Given this characteristic, Kerzner (2020) emphasizes that project management has evolved over time, with the emergence of new project management techniques, especially in software development, among which we can highlight the Agile Methods and the use of the Scrum framework.

2.2 Project Management Methods

For the use of a project management method, it is necessary to consider the needs of each company and its characteristics, since the conduction of the project can be guided by Traditional Methods, such as, for example, the knowledge presented in the PMBOK® Guide of the Project Management Institute (PMI), or by Agile Methods with their frameworks, such as Scrum.

Menezes (2018) points out that, while Traditional Methods have a good definition of scope, focus on planning, documentation generation, and risk analysis, among others, Agile Methods have as their characteristic the ability and speed to provide solutions to changes in the development of a project, whether technical, human resources or related to its requirements.

In this regard, it can be inferred that, according to a comparative study carried out by Silva, Souza and Camargo (2013), while the traditional approach is based on a more strategic and formal level, Scrum aims to operationalize project management in an informal and collaborative way. As seen, each method has it's intrinsic characteristics, therefore, when opting for the change in the use of Traditional Methods for Agile Methods, such a decision must take into account the need for a new perspective in the culture of institutions, with a transformation in the way in which the execution of these projects were carried out and how they will be conducted from then on.

As highlighted by Ribeiro and Ribeiro (2015), there are several types of agile approaches, such as Lean, Kanban, eXtreme Programming (XP), SMART and Scrum itself, among others, which seek in essence to fulfill the 04 (four) principles from the document produced by the Agile Manifesto, which emphasize the following aspects:

a) **Individuals and interactions** over processes and tools;
b) **Working software** over comprehensive documentation;

c) **Customer collaboration** over contract negotiation;

d) **Responding** to **change** over following a plan.

In addition, we highlight the 12 guiding principles contained in the document, which aim, among other aspects, to provide continuous delivery of value to the customer, through frequent software deliveries, reflection on how to become more effective in all time intervals, increase agility, observing excellence, technique and good design (AGILE MANIFEST, 2001).

2.3 Scrum

Created by Ken Schwaber, Jeff Sthherland and Mike Beedle, Scrum is an agile management framework based on a 1986 article written by Hirotaka Takeuchi and Ikujiro Nonaka for the Harvard Business Review, whose premise is to help teams and organizations generating value through adaptive solutions to complex problems (SCRUM GUIDE, 2020). In this regard, Ribeiro and Cunha (2015) highlight that Scrum is an agile method that employs an iterative and incremental approach aimed at improving predictability and risk control.

According to the Scrum Guide (2020), the framework is based on three (03) pillars: Transparency, Inspection and Adaptation.

Transparency regarding the visibility of the process that those responsible for the result should have; frequent inspection of artifacts and their progress to detect variations; and adaptation to scope deviations that end up producing an increase where the result will be unusable.

The structure has five values: commitment, focus, openness, respect and courage; which integrate it's success, and some events that have been designed to inspect and adapt it's artifacts, bringing the necessary transparency to it's execution.

Scrum has formal events for inspecting and adapting its artifacts (SCRUM GUIDE, 2020), which include:

a) Sprint: this is a container for all other events, with a fixed duration of one month or less, which aims to bring predictability and guarantee inspection and adaptation of progress, and some practices can be used to measure its progress, such as burn-downs, burn-ups or cumulative flows charts;

b) Sprint Planning: with a Time box of maximum duration of 08 (eight) hours, this event seeks to address the importance of the Sprint, define which backlogs will be included, and how they will be decomposed to create an increment that meets the definition of done;

c) Daily Scrum: aims to inspect progress towards the Sprint Goal and adapt the Sprint Backlog as necessary. The event lasts 15 minutes in which the Developers participate, as well as the Product Owner or the Scrum Master, if they are actively working on the Backlog items;

d) Sprint Review: the purpose of this event is to inspect the result of the Sprint and determine future adaptations. It is also where the Scrum Team presents the results of its work to the main Stakeholders, as well as discussing the progress towards the Product Goal, which should not exceed a maximum period of 04 (four) hours.

e) Sprint Retrospective: aims to plan ways to increase quality and effectiveness in development, in which the Scrum Team discusses what went well during the Sprint, what problems they encountered, and how these problems were (or were not) resolved. The event is Time box limited to a maximum of three hours.

2.3.1 Benefits in the Application of Scrum in Public and Private Companies

Oliveira et al. (2023) present an analysis of the application of the Scrum method in Federal Universities, in which they show greater productivity and improvement in team learning as consequences of the use of the method, highlighting that two sub-attributes (Communication and Collaboration) were identified as benefits in the use of this method, which is corroborated by Sathe and Panse (2023), which highlight that agile project management places a strong emphasis on Teamwork and Communication, which is especially useful for managing risks.

Arruda (2020) implemented and analyzed the application of Scrum in a private software development company in Florianópolis - SC, which had been experiencing management problems and was unable to deliver its projects on time.

After applying the framework, the researcher obtained as a result the delivery of 3 (three) projects, all within the stipulated period, highlighting the following elements for its success: (a) the delivery of value at the end of each Sprint; (b) access to information provided by the daily meetings held; and (c) follow-up of project development through the burndown chart.

Simoyama and Bueno (2016) also applied the framework in a Federal Autarchy, obtaining as a result the improvement in the fulfillment of tasks by managers, especially in those that had Performance and Deadline Indicators (IDPs); it also found a smaller number of complaints about the routine activities of functional managers.

Marnewick and Marnewick (2022) also highlight the benefits of an agile environment compared to the traditional method, since, in the agile model, deviations are detected earlier, due to the adaptive and iterative approach, allowing correction as soon as possible to maximize the Benefits.

Ravaglia et al. (2021) report that the main positive points in using the Scrum method are: speed of delivery, maximization of results, problem prevention and customer involvement, as well as simplicity, standardization and reuse, compliance and quality.

Al Maamzi and Tawfik (2022) add that Scrum is a method for dealing with complex projects with inaccurate results to minimize development-related risks. The framework helps resolve uncertainty and respond to change by providing a set of principles and guidelines for being more productive.

2.3.2 Barriers encountered in Scrum Application

León (2020) mentions in his study some difficulties encountered in the application of the Scrum method in the management of a project by the Asociación Navarra de Informática Municipal (ANIMSA) of Pamplona - Spain, in which he reports that it was not possible to apply it in its entirety. The author identified that such difficulties were related to the characteristics of the company, which was a public entity, and therefore was subject to internal regulations that conflicted with some aspects established in the Scrum method, which brought obstacles to its complete execution.

Conceição (2019) also presents in its analysis some barriers found that made it impossible to apply agile methods, namely:

a) The distance from senior management in large enterprises, which directly reflects the relationship between the project teams and the top of the organization;

b) Uncertainty aversion, which translates into dysfunctional rules that end up stifling information technology (IT) organizations;

c) Perception by the employees of the company that they were not implementing all four values of the Agile Manifesto, due to the barriers related to the Brazilian context.

Ravaglia et al. (2021) cite in their research that 21% of respondents identified the need to complement the framework with other agile development management tools in order to control documentation and code versioning requirements.

Also, Gupta et al. (2022) describe the difficulty in defining deadlines and the need for the team to go through a stress test process to ensure quality as a limitation of the method.

As noted, there are studies that show the benefits in using the framework, while others show some barriers in its application, as described in Table 1.

Table 1 – Benefits and Barriers in the Application of framework Scrum

Benefits	Author
Greater productivity and improvement in team learning and improvement in Communication and Collaboration.	Oliveira et al. (2023)
Earlier detection due to the adaptive and iterative approach, allowing for correction as quickly as possible to maximize Benefits.	Marnewick and Marnewick (2022)
Resolve uncertainty and respond to change by providing a set of principles and guidelines for being more productive.	Al Maamzi and Tawfik (2022)
Delivery of 3 (three) projects, all within the stipulated period.	Arruda (2020)
Speed of delivery, maximization of results, problem prevention and customer involvement.	Ravaglia et al. (2021)
Improvement in the fulfillment of tasks by managers.	Simoyama and Bueno (2016)
Conflicts of internal regulations of the company.	León (2020)
The distance from senior management in large enterprises; Aversion to uncertainty; not implementing all four values of the Agile Manifesto.	Conceição (2019)
Need to complement the framework with other agile development management tools	Ravaglia et al. (2021)
Difficulty in defining deadlines.	Gupta et al. (2022)

Source: Done by authors (2023).

3. RESEARCH METHODOLOGY

Regarding methodological procedures, the research was based on the broad inductive method, as it fits the project proposal, which analyzes some particular phenomena and establishes a general conclusion on the subject, which corroborates Mezzaroba and Monteiro (2009).

As for the approach strategy, a bibliographical research and case study was carried out, with qualitative research as the approach to the problem. The bibliographical research was selected to raise in the literature the concepts of project management, Agile Methods, Scrum framework, processes related to its implementation and application in the development of systems in public and private institutions, as well as barriers that can interfere in its application.

The Case Study was chosen because it is used in research in which the researcher has little control of the events to be analyzed, and the focus is on contemporary phenomena inserted in a real-life context, which is the case of this project (YIN, 2017). In this aspect Yin (2017) defines the phases for conduction of the case study, in: preparation, collection of evidence, analysis and report.

The Case Study allowed the direct observation of the application of the Scrum framework in the company under analysis, through documentary verification, direct observation of the researcher and application of questionnaires to the Stakeholders, Scrum Master (SM) and Product Owner (PO) involved in the projects.

Regarding the research approach, this was carried out in a qualitative way, since the project focused on obtaining data directly in the study environment, as recommended by Prodanov and Freitas (2013).

Regarding the time of the research, its application was developed in a transversal way, since it is based on the contemporary context of the organization studied, in which the factor and effect are observed within a space of time, not taking into account its development in a period history, which corroborates with Rouquayrol (1994) apud Bordalo (2006).

As for the nature of the research, it was carried out in an applied way, because the interest of the study was based on practical and directed application, aiming to generate knowledge on the subject (GIL, 2008; COOPER and SCHINDLER, 2013).

Regarding the research objective, an exploratory study was developed in order to obtain familiarity with the research problem and thus make it more explicit and carry out the construction of hypotheses about its results (GIL, 2002, p. 41) that sought to demonstrate how agile project management using the Scrum framework contributes to improving systems project management for a public organization.

For this, we seek to collect data through questionnaires with the Scrum Master, Product Owner and Stakeholders, in addition to direct observation by the researcher. The structured questionnaire aimed to obtain information on the subject, which was standardized, because there was a previously established script to be followed (SILVA and MENEZES, 2005). However, direct observation was linked to the scenario under study, aiming at data collection, so that it was possible to examine the facts and phenomena involved in the process of the method under study (LAKATOS and MARCONI, 2003).

The survey was based on a sample with the participation of 10 respondents, of which 05 (five) corresponded to the Scrum Team of the software factory, consisting of 03 (three) Scrum Master and 02 (two) Product Owner, and 05 (five) Stakeholders of the contracting company, comprising 100% of the entire existing sample for the study at the time of the survey.

The research instrument used for the questionnaire was scripted and divided into 03 (three) parts, each directed to the perspective of each respondent, however, encompassing the same themes, totaling 37 (thirty-seven) questions for the SM and PO, and 31 (thirty-one) for the Stakeholders.

Its structure focused on identifying the level of experience with the Scrum framework, the Scrum Team's performance in ongoing projects, and its application in relation to the processes defined in the literature. Complementary, a documentary analysis was carried out in order to corroborate and enhance the evidence from other sources, in which the data available in the Team Foundation Server (TFS) tool was taken as a basis.

4. RESULTS

The organization object of study acts as a third-party company, responsible for providing services such as a Software Factory, providing solutions aimed at the demands of Administrative and Operational systems.

The systems managed by the company are focused on Web and Mobile platforms, in addition to some legacy versions in Desktop. Its effort is focused on maintaining this software and developing new technological solutions, according to the projects that are received by the Public Institution for execution.

The company has four development teams and one support team, essentially composed of 01 Scrum Master (SM), 01 Product Owner (PO) and Developers.

The Table 02 shows the profiles of the respondents, as well as the number of projects in which they were working in their role during the research.

Table 2 - Profile of the Scrum Master and Product Owner

Respondents	Formation	Function	Certifications	Number of Projects that are Defined in the Function
Respondent 01	Information Systems	Scrum Master	Professional Scrum Master - I and Professional Scrum Product Owner - I	From 02 to 05
Respondent 02	Graduated	Scrum Master	Certification ITIL v3 Foundation	From 02 to 05
Respondent 03	Bachelor of Mathematics	Scrum Master	Certification ITIL v3 Foundation	From 02 to 05
Respondent 04	Petroleum Engineering	Product Owner	Agile Scrum Master – ASM	01
Respondent 05	Information Systems	Product Owner	PSM-I, PSPO-I, TKP, KSD, PAL-EBM	From 02 to 05

Source: Done by authors (2023).

As for the public company contracting the service, its structure is defined as an Applications and Systems Department, a branch of the Technology Department, focused on providing technological solutions for all the administrative and operational areas under its administration, which has the stakeholders presented in Table 3.

Table 3 - Profile of Stakeholders

Respondents	Formation	Function	Number of Projects you are responsible for
Respondent 01	Graduated in law	Operating Systems Project Manager	18
Respondent 02	Graduated	Administrative Systems Project Manager	22
Respondent 03	Systems Analyst	Operating Systems Project Manager	18
Respondent 04	Graduate Degree	Software Architecture Manager	4
Respondent 05	Graduated	Database, Testing and Quality Manager	3

Source: Done by authors (2023).

4.1 Experience with the Scrum Framework

To verify the level of knowledge about the application of the Scrum framework, Stakeholders were initially asked how much they knew about the method, where zero corresponded to no knowledge and 10 to a lot of knowledge, as shown in Figure 1.
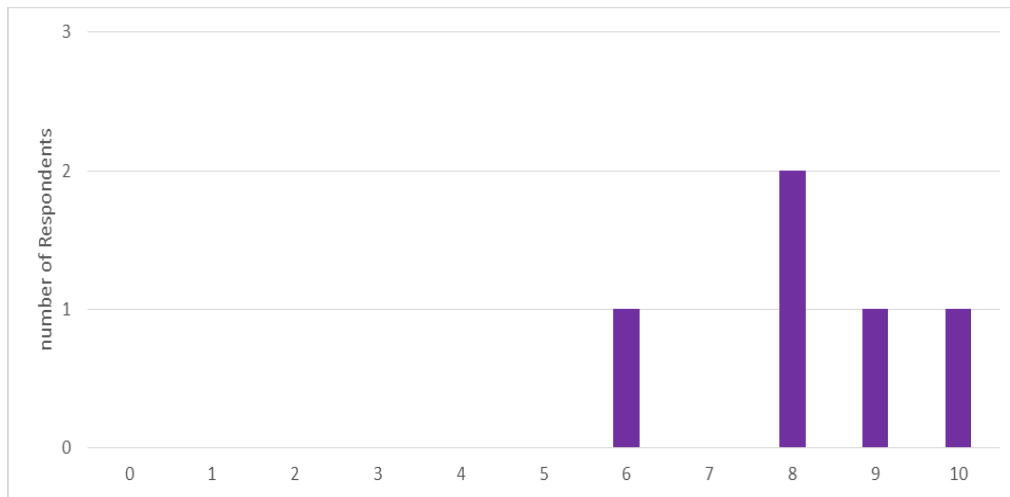
Figure 1 - Experience with the Scrum Framework
Source: Done by authors (2023).

It is observed that 80% of the respondents (4 respondents) declared to have a high knowledge of this picture, assigning a grade above 7. Only one of them claimed to have little knowledge, which is justified by the fact that this respondent had arrived at the Department a few months ago, explaining his low level of knowledge about this framework.

On company's providing service side, Scrum Masters reported that they had been using the framework for more than 3 years and the POs stated that they had been applying it for more than 1 year, demonstrating that the team at the software factory already had a certain degree of experience in using the framework.

4.2 Scrum Team

When asking about the composition of Scrum teams, the participants reported that their total formation ranged from 5 to 9 components, always having 1 SM, 1 PO and Developers, corroborating with what is prescribed by the Scrum Guide (2020) that predicts the existence of these roles, and recommends that the size of the team should not exceed 10 people.

In this context, the interviewees were asked if any of them worked in more than one function in the team, in which two SM reported that they had other functions, including one of them the PO, while a PO reported that he was the SM of the team.

The previous finding shows a concern in the effectiveness of the framework application, since the accumulation of roles brings an overload to the employee. The roles of SM and PO have distinct and complementary functions, along with the fact that PO is directly linked to Stakeholders, while SM needs to be focused on helping the Development team. Thus, such overload increases the chance of an abandonment or forgetfulness of some of these responsibilities, directly affecting the delivery of the product.

In order to verify the self-management that the Scrum Teams had, respondents were asked what level of self-organization the team was at, where 0 corresponded to nothing organized and 10 to fully organized.

In order to observe the variability of the responses provided by each profile analyzed, the data collected were tabulated (Table 4), and a boxplot chart was generated, as shown in Table 4 and Figure 2, grouping each of these profiles, in order to observe the distribution of the data.
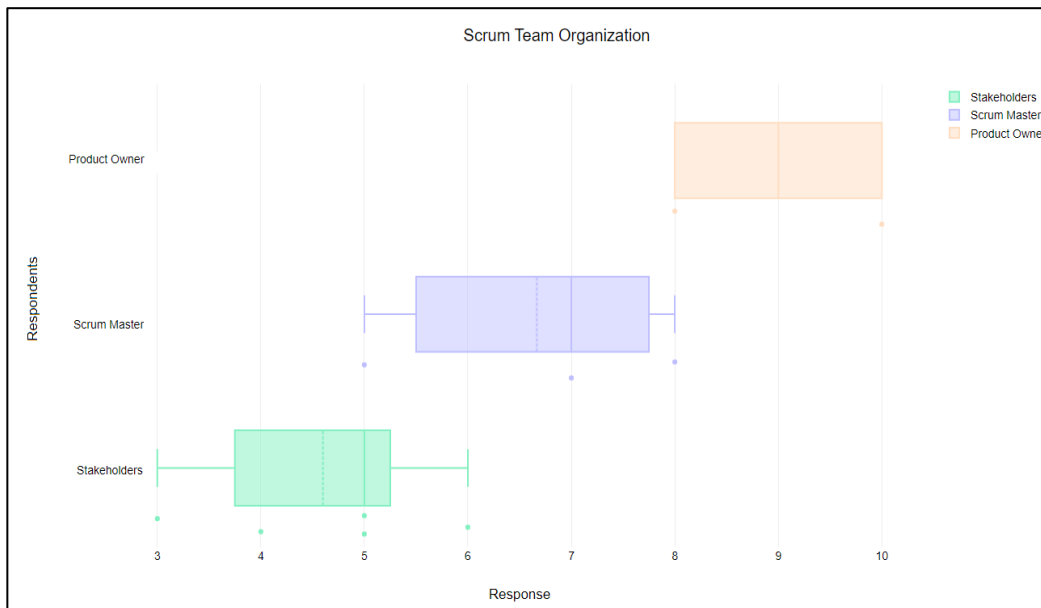
Figure 2 - Scrum Team Organization
Source: Done by authors (2023).

RESPONSE	STK 01	STK 02	STK 03	STK 04	STK 05	MEAN	MEDIAN	STANDARD DEVIATION	COEFICIENT OF VARIATION
	4	4	7	6	3	4,80	4,00	1,64	34,23%
	SM 01	SM 02	SM 03			MEAN	MEDIAN	STANDARD DEVIATION	COEFICIENT OF VARIATION
	7	8	5			6,67	7,00	1,53	22,91%
	PO 01	PO 02				MEAN	MEDIAN	STANDARD DEVIATION	COEFICIENT OF VARIATION
	10	8				9,00	9,00	1,41	15,71%

Table 4 - Scrum Team Organization
Source: Done by authors (2023).

When confronting the information collected, it is observed that the POs believe that the team is fully self-organized, in contrast to the perception of the MS and especially the Stakeholders in which the median predicts a worsening trend in this view. SM believes that the team is partially self-organized, while part of the Stakeholders considers that the team is poorly organized.

In this sense, it is important to emphasize that teams should be multifunctional self-management (SCRUM GUIDE, 2020), and this management should be perceived mainly by the person responsible for the business vision with the client, in the case of PO. In this way, the PO must always be aligned with the customer, knowing their desires and transmitting confidence in the delivery of value, which will directly reflect on the elevation of the level of perception of the self-management team.

The SM are also responsible for the effectiveness of the team, should act to improve their practices and train them in self-management and cross-functionality, to meet the definition of done, which is a formal description of the state of increment, when it meets the quality measures required by the product (SCRUM GUIDE, 2020, p. 13), which also reflects on the team's perception of self-management.

4.3. Product and Business Knowledge

To assess the level of knowledge of the Product and Business, it was asked how much each respondent knew about these items, where 0 corresponded to no knowledge and 10 to a lot of knowledge, obtaining the data contained in Figure 3.
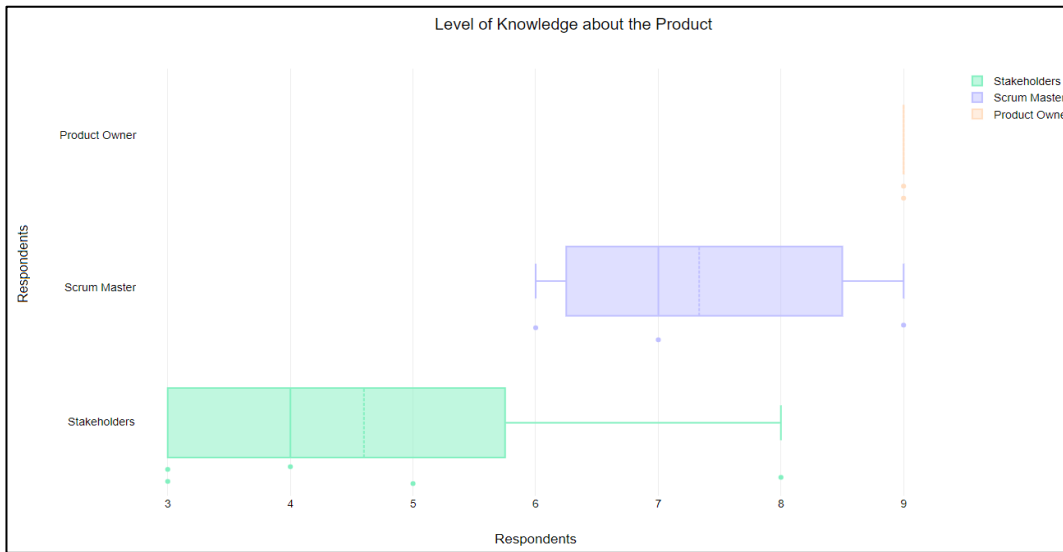
Figure 3 - Level of Knowledge about the Product
Source: Done by authors (2023).

It is observed that of the Stakeholders understand that the team has little knowledge about the Product and when evaluating the median of the Boxplot graph, it is verified that there is a worsening trend in this scenario. SM recognizes that they have an average knowledge of what is executed. However, the POs were unanimous in saying that they are fully aware of the Product.
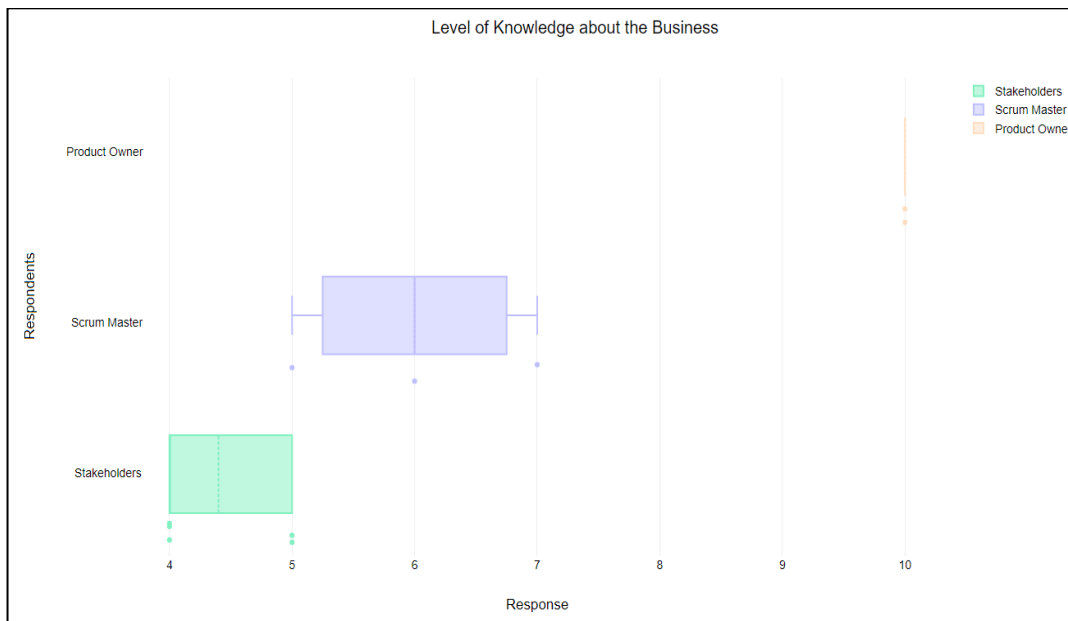

Figure 4 - Level of Knowledge about the Business
Source: Done by authors (2023).

It is a fact that POs should know the Product, since their role is to maximize the value resulting from the Scrum Team Work (SCRUM GUIDE, 2020, p. 7), defining the goal of the product to be achieved. However, some stakeholders do not see that the team has this level of knowledge, which denotes the importance of PO act against this obstacle, trying to understand why this perception exists, improving the relationship between the Customer and the Scrum Team.

Regarding the knowledge of the Business, the data presented in Figure 4 were obtained.

It was identified that the Stakeholders understand that the team has little knowledge about the subject, in which there is still a worsening trend in the scenario, when analyzing the median of the graph, which is corroborated by the SM. The POs considers that it has a lot of knowledge about the business, which goes against what is perceived by the other roles analyzed. It is important to highlight that it is their role to represent the needs of stakeholders (SCRUM GUIDE, 2020, p. 7), so

having the confidence of those represented in terms of being assiduously knowledgeable of the Business is a fundamental task for the conduct of the project.

As noted, although the software factory understands that it is knowledgeable of the customer's business and product in the view of its PO, this statement is not consistent with what was perceived by the Stakeholders and SM, which correlates with the deliveries made. This perception is due to the non-delivery of an expected functionality or the receipt of it outside the specifications, which translates into a lack of correct understanding of what was requested.

4.4 Application of the Scrum framework

Aiming to know how the Scrum framework is applied in the Company, questions were asked about the events that comprise its realization, evaluating each element in line with the constant literature in the Scrum Guide.

4.4.1 Product Backlog

The Product Backlog (PB) is an ordered and emerging list of what is needed to improve the Product (SCRUM GUIDE, 2020), thus, the respondents were asked how often each one participated in its preparation, and how the process of defining these was carried out.

The respondents reported that the Product Backlog definitions are dealt directly with the Stakeholders, which in fact must be done, since the Scrum Guide emphasizes the responsibility of the PO in representing the needs together with the Stakeholders, guaranteeing that they are transparent, visible and understandable (SCRUM GUIDE, 2020, p. 7).

4.4.2 Sprint Planning

Sprint Planning defines the work to be done in the Sprint, which is the heart of Scrum (SCRUM GUIDE, 2020, p. 9), as it is where backlogs are refined and transformed into value. Thus, the interviewees were asked about the frequency with which they participated in their planning and how it was carried out, in which it was reported by all SM and PO who always participated in this event and by the Stakeholders who participated in it when requested.

Stakeholder participation in Sprint Planning should not occur, since this phase is focused on the selection of Product Backlog items to be included in the current Sprint. In this sense, the participation of other people besides the Scrum Team components is a bad Scrum practice, since at this time all the work is already known, and such event focuses only on the selection of items to be executed in the Sprint.

He was also asked about the existence of any tool to mark and estimate the execution time of each Sprint, in which the use of the Team Foundation Service (TFS) tool was reported.

Two SM and one PO reported that there was no tool to delimit the item pointed out, which indicates their lack of knowledge of the tool used by the company.

In addition, the interviewees were asked about the level of difficulty in elucidating user stories (User Story), a technique in which the user's need for the product is described simply and lightly, where 0 corresponded to no difficulty and 10 to much difficulty, obtaining the results presented in Table 5.

Table 5 - Level of difficulty in elucidating user stories

	STK 01	STK 02	STK 03	STK 04	STK 05	MEAN	MEDIAN	STANDARD DEVIATION	COEFICIENT OF VARIATION
	9	9	8	7	6	7,80	8,00	1,30	16,72%
	SM 01	SM 02	SM 03			MEAN	MEDIAN	STANDARD DEVIATION	COEFICIENT OF VARIATION
RESPONSE	9	9	8			8,67	9,00	0,58	6,66%
	PO 01	PO 02				MEAN	MEDIAN	STANDARD DEVIATION	COEFICIENT OF VARIATION
	2	2				2,00	2,00	0,00	0,00%

Source: Done by authors (2023).

When analyzing the results of Table 4, it is verified that the Stakeholders and SM have a median above the average found, being between 8 and 9, which indicates that there is a lot of difficulty in understanding what is requested in the stories of the users. While the PO believes that there is very little difficulty in understanding them.

The PO has opposite perceptions of the others involved, which can be considered plausible, since they must be assiduous experts of the elements that contemplate the needs of their

representatives.

In this sense, it is important to highlight that it is the function of SM to seek the effectiveness of the Scrum Team (SCRUM GUIDE, 2020), so when the team has an impediment or barrier, as in the case of not understanding what needs to be done, it is the SM that should elucidate such points along with the PO. In addition, the PO must refactor the user stories if necessary in order to reduce the risks of generating a useless artifact, which will lead to a delivery of no value to the customer.

4.4.3 Daily Scrum

The Daily Scrum aims to inspect progress towards the Sprint Goal (SCRUM GUIDE, 2020, p. 10). Thus, the interviewees were asked if this event was held, and how often each of them participated, in which the SM and PO informed that the event is always held, and that they participated in it frequently. As for the Stakeholders, they reported that, when requested, they also participate in the event.

The Daily is focused on Developers, so the fact that Stakeholders participate, are only plausible if the goal is related to the understanding of some exclusive item for your consideration. However, the effective and constant participation, besides not foreseen, turns the event into a meeting, thus breaking its purpose, which has the premise of being short and with a maximum duration of 15 minutes.

4.4.4 Sprint Execution

In the survey, respondents were asked about how the execution time of each Sprint is defined, in which it was reported that it is in common agreement between the SM, PO and Stakeholders, that its duration is two weeks, being in accordance with the provisions of the Scrum Guide, that defines a duration of one month or less for that event.

4.4.4.1 Scope Change

When checking with the interviewees if there were scope changes during the Sprint, what was the frequency of these events and how they were treated; SM and PO reported that this tends to occur sometimes, and that when this occurs, it is evaluated whether the impact will compromise the delivery. If it is understood positive, the item is removed and prioritized again. Otherwise, the item is incorporated into the Sprint and executed normally.

4.4.4.2 Change of Priority

The respondents were asked if there were changes in the priorities established for the execution of the Sprint, in which all the Stakeholders reported that this happened sometimes, which were dealt personally with the SM or through e-mail with the Factory manager. The PO reported that there was never any change of priority in the project.

Among the twelve principles of the Agile Manifesto are adapting to changing requirements, even late in development, seeking to provide a competitive advantage for the client. However, the Scrum Guide emphasizes that all changes must occur upon convincing the PO (SCRUM GUIDE, 2020, p. 7), who is solely responsible for this, which was not verified during the research, since the PO reported not being aware of such changes and, by not passing his scrutiny, may have put Sprint at risk.

Grebic (2019) highlights that using the Scrum method and its agile values, shortens the planning period, fosters cooperation with Stakeholders and reduces adversity to change, allowing an improvement in cost control, avoiding unnecessary expenses and increasing the chances of early profit. Thus, changes that are focused on this aspect can and should be seen with good eyes to provide value to stakeholders.

4.4.4.3 Relocating a Scrum Team component

Another aspect addressed was whether there was a reallocation of a team member to other demands other than those defined for the Sprint, and what the perceived impacts were when this occurred. Two SM answered that the reallocation of a component usually happens sometimes, while another reported that it always happens.

Regarding the perceived impacts, when relocating a component, there was a loss of time for redeployment of the team, reduction of the outlined scope, or even failure to deliver the product, which is corroborated by Kadenic et al. (2022) who highlight the reduction in productivity when frequent changes occur in the team.

4.4.4.4 Other factors influencing Product Delivery

It was also raised whether there were other factors that influenced the completion of the objectives set for the Sprint, in which it was reported by the SM that when the client requests the prioritization of another project, the delivery is affected. Another reported aspect was the removal of a team member to work on support demands outside the Sprint, which is often requested by Stakeholders. Problems were also reported with the deployment environment of applications in production, which delays the delivery of the product.

In terms of the PO's view, they expressed that there were no difficulties in meeting the goals set in the Sprint. As for the Stakeholders, they reported that when there were difficulties in delivering the Product, they were informed by sending an e-mail, scheduled meetings, or even in person.

Another aspect assessed was whether there was a need to abandon some agile practice, to the detriment of meeting the Sprint objective, as well as what were the main factors for this to happen. In this sense, it was reported by the SM and PO that such facts occurred due to unenforceable deadlines, or even, due to the performance of the team that, even after the end of the Sprint, continued to work to deliver the uncompleted item.

Regarding "extending" a Sprint, the Scrum Guide provides that when verifying that one or more Product Backlog Items do not meet the definition of ready at the end of the Sprint, it must return to the PB for a new prioritization. In this way, the SM, when verifying such intercurrence, should proceed as the guide determines, since it is responsible for maintaining the theory and practice of Scrum.

As for the impossibility of solving a PBI due to an unenforceable deadline, each PBI is duly discussed by the entire Scrum Team, which has the expertise on the time to complete a demand. Thus, when realizing that an item has an unenforceable deadline, the guide itself proposes that the PBI be refined and broken down into smaller and more precise items (SCRUM GUIDE, 2020, p. 12), so that its execution is plausible and that value delivery to the customer occurs.

4.4.5 Sprint Review

The premise of the Sprint Review is to inspect the results obtained in the Sprint, thus, it was raised in the sample, if the referred event was held, and how often they used to participate, being highlighted by all, that the event was always held.

As for participation, Stakeholders reported that they always participate. The POs reported that they participate sometimes, and one of the SM replied that they participate sometimes. While all the others reported that they always participated, which denotes the importance of the event, since it is there that the results obtained are inspected and future adaptations are determined (SCRUM GUIDE, 2020, p. 10).

The Sprint Review is a section of work conducted by the Scrum Team, therefore, it is essential that the SM participate in the event, also, because things that will be done in the sequence are decided there. Thus, the report of non-participation of a SM in some of these events, besides not being foreseen by the guide, conveys a feeling of abandonment to the team.

4.4.6 Sprint Retrospective

The Sprint Retrospective aims to plan ways to increase the quality and effectiveness of the Scrum Team. For this, it is evaluated what was done correctly, what problems were found and how these were or weren't solved.

To this end, the respondents asked whether the referred event was held, and how often they used to participate, in which it was answered by all that the event was always held.

As for participation, some Stakeholders reported that they always participated, and the others reported never participating. The POs reported that they always participate and, in relation to the SM, only one answered that they participate sometimes, while the others reported that they always participate.

Sprint Retrospective is an event oriented to the Scrum Team, in which positive actions is discussed, what problems were encountered and how these were solved or not (SCRUM GUIDE, 2020, p. 11). Therefore, the presence of Stakeholders, in addition to being unforeseen, ends up causing discomfort to the other team members, limiting discussions for fear of internal exposure, or even diverting their focus to a meeting between the team and the Stakeholders.

As reported, the above event is oriented to the Scrum Team, which is composed of a SM, a PO and Developers (SCRUM GUIDE, 2020, p. 6). This way, the answer of one of the SMs that he sometimes attends the event causes surprise, since it is his duty to attend the event in question, together with the fact that it is his responsibility to establish Scrum according to the guide, helping everyone to understand the theory and the practice (SCRUM GUIDE, 2020, p. 7).

4.5 Level of satisfaction with Deliveries Made

To assess the level of satisfaction with the deliveries made at the end of each Sprint, Stakeholders were asked, on a scale of 0 to 10, how each of them would rate their satisfaction with the deliverables, where 0 corresponded to totally dissatisfied and 10 to fully satisfied, obtaining the results of Table 6.

Table 6 - Level of satisfaction with Deliveries

RESPONSE	STK 01	STK 02	STK 03	STK 04	STK 05	MEAN	MEDIAN	STANDARD DEVIATION	COEFICIENT OF VARIATION
	3	4	5	5	6	4,60	5,00	1,14	24,79%

Source: Done by authors (2023).

Table 6 and Figure 5 demonstrate the low level of satisfaction of the Stakeholders, in relation to the deliverable items, in which a median of 5 is observed, and standard deviation of 1.14, which means that everyone has the same perception of dissatisfaction with the results presented.

Regarding how this perception of satisfaction is measured by SM and PO, it was asked how they were able to assess the level of satisfaction of the results delivered to the Stakeholders, in which it was answered that this was done during the Sprint Review, through verbal feedback.
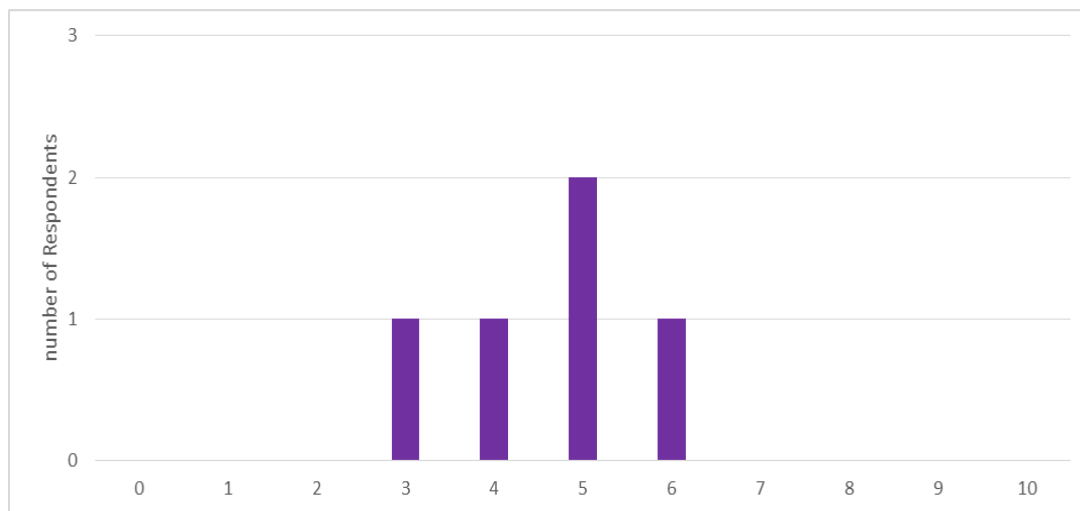

Figure 5 - Level of satisfaction with Deliveries
Source: Done by authors (2023).

When analyzing the presented results, it is verified that changes in the principles and processes contained in the Scrum Guide directly affect the quality of value delivery, causing dissatisfaction with the deliverables, which reflects in the perception that the team, in the figure of the PO, does not know the business and the product.

In this sense, it is essential that the software factory adapts to what is contained in the framework, and that the PO and SM act within their proposed role, seeking, in this way, to provide high-value increments. Another preponderant factor is the scope and priority changes during the Sprint execution without the consent of the PO, which increases the complexity and, consequently, the risks of non-delivery of value. For this, any and all changes must be evaluated by the PO, and if this entails risks to the delivery, it must be prioritized for the next Sprint.

Another aspect of attention is the allocation of team components to other demands during the Sprint execution, which also directly affected the delivery of value by the team.

4.6 Document Analysis

Regarding document analysis, these were accessed through the TFS platform, a place informed by respondents as a repository of all code and documentation.

This tool has several services aimed at this segment, such as Boards for monitoring jobs, tasks or problems, Repositories for code versioning, Pipelines for process automation, Test Plans and a multitude of other features.

The interviewees also mentioned the use of the Kanban framework, an organizational development tool (KANBAN, 2021), in which the work phases are allocated in frames that move from left to right, going through all the defined phases, until the delivery of the value to the customer.

As for the analysis of documents, it was limited to the user stories, because when accessing other directories that contained different folders, such as prototypes, test documents and support, no document was found inside, which was repeated in other accesses to different projects.

Access to the documents was carried out through links contained in the PBIs, in which it was verified that its structure was divided in: description of the user story, functional and non-functional requirements, prototypes and attachments.

The User Story is the technique of describing the user's need for the product in a simple and light way. However, when questioning the respondents about the difficulties in elucidating these stories, the SM and Stakeholders reported a high degree of difficulty in understanding them.

When reading these documents, their structure was adequate to the proposal, however, the systems developed by the software factory have a high degree of complexity in their business rules, which causes this mentioned difficulty. Thus, a simple description may not be enough for these cases, and such narratives should be complemented with an approach to the general scenario of the system in which it is inserted, thus reducing rework in its preparation.

Some projects in progress and their Product Backlog Items (PBI) were also evaluated, which contained Sprints that had been closed and others in progress.

When checking their PBI, they were well structured, which had various information, such as creation date, person in charge, attached documents, and Status, the latter containing values such as "in Progress", "In Execution" or "Done", and others such as "Canceled". However, when making a brief comparison between some of them, inconsistencies in their statuses were identified, such as some having the value "under development", but that, in fact, were queued for execution, others with the status "In execution", but that had been completed.

In this sense, it became evident that the information presented did not correctly reflect the current scenario of each project, reducing the possibility of an assertive inspection, both by the management of the contracted company and by the contracting party.

Although the Manifesto for Agile Software Development values working software more than comprehensive documentation, when you are working with companies that need more comprehensive documentation, your writing should stop being succinct, encompassing a slightly more in-depth narrative, improving the its understanding by both the Stakeholders and the Scrum Team.

5. CONCLUSION

The work in question aimed to demonstrate a case study on project management using the Scrum framework in the development of systems for a public organization.

The study showed that the products that were delivered did not meet the expectations of the stakeholders, which occurred due to the partial application of the framework, not respecting the responsibilities related to each planned role, and violating some rules imposed for each event, as in the case of the Sprint that was continued by the team, even after its end, which ended up reducing the benefits that its application could provide.

Kadenic et al. (2022) point out that the events prescribed by the Scrum Guide must be followed and that companies that deviate from this context create anti-patterns, interfering with the benefits that can be achieved.

Initially, it can be inferred that the accumulation of roles by some members of the Scrum Team contributed to this result, which caused an overload of functions, reflecting directly on the effectiveness of the team. By taking on many responsibilities, the areas were left unattended, the events were forgotten, the rules were ignored and the actions that should have been taken were not executed, corroborating the delivery of a product that did not add value to the customer.

Another preponderant factor is linked to the reallocation of Scrum Team components to other projects during the course of the Sprint, which caused a loss of time for the team to adapt, reflecting in the reduction of the outlined scope, and, in some cases, even in the failure of the product delivery.

Kadenic et al. (2022) corroborate the above, which report that the empirical knowledge acquired over time leads the team to maturity and that mature teams tend to make the use of the framework a success. Thus, frequent changes in the team, such as those mentioned above, end up directly affecting this maturity, reducing productivity and generating deliveries of lower value to the customer.

The second aspect observed was the lack of alignment between the Stakeholders and the PO, since they had completely different perceptions, which reflected in the inability to maximize the

effectiveness of the Product Backlog generated.

In the Stakeholders' perception, it was observed that priority changes were often made directly to the company's managers, or to the SM, however, the decision for this to occur must come from the PO, who is solely responsible for doing so. It is worth highlighting the importance of breaking paradigms related to sector hierarchies commonly existing in public organizations, seeing the figure of a manager in a framework that does not provide for this type of division. For a change to occur, the PO must be convinced of it, being the one who has the final word, which must be respected by the entire organization (SCRUM GUIDE, 2020, p. 7).

It was also observed that some developers were called upon, during the course of the Sprints, to provide support to external demands, many of which were requested by the Stakeholders, which interfered with the team structure, resulting in a decrease in the ability to deliver value.

Another preponderant factor was the high level of difficulty reported by Scrum Masters in understanding the information contained in user stories, a fact corroborated by the Stakeholders themselves who are the ones who define these needs. Which reflects directly on Sprint Planning, when the team measures and evaluates what will be done during the current Sprint.

Regarding the management tool, despite containing all the information relevant to the project, the lack of frequent updating corroborates that an assertive inspection is not possible, making it difficult for any attempt to obtain a reliable management report by the service provider or by the contractor.

That said, it is concluded that the work carried out demonstrates that when implementing the principles of projects with the Scrum framework, it is essential that all roles and events are strictly followed, certain that, by ignoring the rules contained in the guide, the risks are high and deliveries do not add any value to the customer, making the use of the framework something totally frivolous.

In this aspect, the work contributed in the sense of presenting factors that affect the effectiveness of the application of the Scrum framework, denoting bad practices that, when carried out, reduce the capacity to deliver value and bring the perception of inefficiency in the application of the method.

It is also important that the tools used for project management are always up to date, reflecting the real situation of the scenario in execution, which brings transparency, allows inspection, and provides, if necessary, adaptability, fundamental pillars contained in the Scrum framework.

As future research, it is suggested an in-depth analysis of the reasons that lead to the displacement of team members during a Sprint, and what are the impacts caused for the company during this event.

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