C2 Center dealing with the unexpected: resilience and brittleness during FIFA Confederation Cup

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ABSTRACT

Forecast and plan response to incidents are fundamental to create a Command and Control Center (C2 Center). However, some incidents are considered chaotic and are completely understood only after happening. These unforeseen incidents pose challenges to plans of such centers and if not properly managed, may result in failures. This article describes how the Integrated C2 Center of Rio de Janeiro City (CICC-RJ) responds to violent, unexpected and improbable events, especially related to protests that took place during the 2013 FIFA Confederations Cup. It aims to describe from the resilience engineering point of view how the CICC-RJ function to cope with incidents, where the structure has proved to be resilient, where it holds brittleness, and to suggest possible actions to help the center to become more resilient to upcoming events.

Keywords

C2 Center, protests, unexpected, Rio de Janeiro, Resilience

INTRODUCTION

In the next three years Brazil will host two major events: FIFA World Cup 2014 and Rio 2016 Olympics Games. Both represent a major challenge for Brazilian security and safety forces, in particular to Rio de Janeiro State. Agencies that work with security, health, transportation and public services must be able to manage daily operations and support these major events. In the Rio de Janeiro State, the Integrate Command and Control Center of Rio de Janeiro (CICC-RJ, Portuguese acronym for Centro Integrado de Comando e Controle do Rio de Janeiro) is responsible to coordinate actions to keep the system working smoothly and to support the upcoming major events. The goal is to keep and support daily security and health actions and respond to incidents in these events, mainly linked to threats like terrorism, hooliganism, illegal sale of tickets, robberies, epidemics and protests. The CICC-RJ is a new C2 Center based on the C2 Model (Builder, Bankes and Nordin, 1999).

In 2013, the CICC structure and operation was tested during the 2013 FIFA Confederations Cup. The event was planned six years in advance and included extensive studies and planning for the prevention and recovery of a wide range of incidents. However, during the Cup, something unusual for Brazilian standards occurred and this caused a big surprise to public service agencies. For the first time in more than 20 years, thousands of Brazilians went to the streets to protest for political and economics' reasons and many of these protests were characterized by violent clashes between protesters and security forces.

The aim of this paper is to analyze, through a scientific perspective, how the CICC-RJ behaved face of the unknown and discuss aspects of resilience and brittleness of the organization against these incidents. To do this we used several techniques of Cognitive Task Analysis (CTA) (Crandall, Klein and Hoffman, 2006) to better understand the decisions made by people who worked at the Command and Control Center.

The Protests in Brazil

Historically, Brazil is averse to protests (Holanda, 1995; Schwartzman, 2007). There are large time intervals between popular uprisings. The last huge protests that took place in Brazil before 2013 occurred in 1992. At that time, students, politicians, trade unions, and a part of the population joined to demand the impeachment of the first democratic elected president of Brazil after almost 30 years of military dictatorship government. In March 2013, the public transportation tariff increases in several Brazilian cities. It was the catalyst for a series of small protests that began in the cities of Porto Alegre and Manaus (G1, 2013). In June of the same year, when the country was ready to host the 2013 FIFA Confederations Cup, these manifestations gained millions of adepts and spread to several cities in almost all Brazilian states. The protests of June 2013 presented new features and consequently it has imposed new challenges for the CICC-RJ. The first major difference between these protests to those organized before was the fact that there was no political or social leadership. The events were organized through social networks and not by traditional calls from unions, social organizations or political parties (Globo, 2013). Another difference is that these protests did not have one specific cause. There was a range of demands like the decrease in public transportation fares, better public transportation, education investment, recognition of the role of women in the professional market, end of corruption, public services improvement and others (BBC, 2013; RFI, 2013). The use of internet and social networks technologies like Twitter, Facebook and YouTube was another singularity during June protests. These technologies were used to assemble the mass of protesters, disseminate the actions, record, and play the results. The most unexpected component of these protests was the violence that characterized some of them. Depredation of public and private buildings, people injured, Molotov cocktails, rubber bullets, tear gas, explosions, incendiary actions and six deaths directly linked to the protests (Estadão, 2013). The last major violent clash between security forces and the population had occurred in 1968 during protests calling for the end of military dictatorship in Brazil. The CICC-RJ had to react to an event without precedent, ensure public safety and security, maintain active public services and support the football games that would occur in Rio de Janeiro, including the Confederations Cup final match.

RELATED WORK

The objective of this paper is to provoke a discussion about resilience (Dekker, 2006; Gomes, Woods, Carvalho, Huber, and Borges, 2009; Hollnagel, 2006; Woods, 2006) applied to Command and Control Center (Builder et al., 1999; Letsky, Warner, Fiore, Rosen and Salas, 2007) facing unexpected situations (Calderon, Johnson and Hinds, 2013; Grant, Van Fenema, Van Veen and Neerincx, 2007; Paggoto and O'Donnell, 2012; Vassilou and Alberts, 2013). In this study, special emphasis was given on aspects of communication (Calderon et al., 2013; Grant, Geugis and Jongejan, 2013; Kuula, Auvinen, Kauppinen, Kettunen, Viitanen and Korhonen, 2013), knowledge management (Axelsson, 2006; Diniz, Borges, Gomes and Canós, 2005; Klein, Calderwood and MacGregor, 1989; Schimitt and Majchrza, 2012), infrastructure and integration (Botterell and Griss, 2012; Clark and Jones, 1999; Dekker, 2006; Hamilton, 2002; Lanfranchi, Mazumdar and Ciravegna, 2013) in order to obtain better understanding of the CICC-RJ and analyze it from the perspective of resilience engineering.

An interesting point of the study is that it occurs at the beginning of a whole new moment for Brazil. The country will host in 2013 the FIFA Confederations Cup and the World Youth Day. In 2014 the FIFA World Cup and the Olympic and Paralympic Games in 2016. It is the first time an integrated command and control center is used in the nation and therefore it becomes necessary to study security and safety actions in major events like the Beijing (Yu, Klauser and Chan, 2009) and London (Armstrong, Hobbs and Lindsay, 2011) Olympic Games, and 2010 FIFA World Cup (Cornelissen, 2011) to understand how these countries prepared to receive such events and the lessons they learned.

CICC STRUCTURE AND OPERATION

Integrated Command and Control Systems (ICCS)

A key factor for the success of C2 systems is the interoperability among participants and agencies (Clark and Jones, 1999; Hamilton, 2002). Actions such as those in which C2 centers are involved are: interconnected, interdependent and ubiquitous (Letsky et al., 2007). "Command and Control (C2) systems are designed and developed to support communication and collaboration between operators in an emergency, with a particular focus on operators in a Command and Control Centre." (Lanfranchi et al., 2013) The design basis for an Integrated Command and Control Center is that all tasks must be integrated in the C2 system.

The ICCS is composed by: the National Integrated Command and Control Center (CICC-N) responsible for

coordinating security and safety actions at the national level (borders, national guidelines, international relations, etc.).; six Regional Integrated Command and Control Center (CICC-R), as CICC-RJ described in this article; Local Integrated Command and Control Center (CICC-L) which is an outpost of the CICC-R, located inside stadiums where matches are held, with the task to manage security on a local level, coordinating operational activities, establishing a partnership between public and private security; and Mobile Integrated Command and Control (CICC-M) that are adapted trucks that aim to provide tactical support to the CICC-R . They are equipped with communications systems, video monitoring and event management systems.

Sharing the information and experiences among the government agencies and CICC-R was originally planned to take place through a daily process called Daily Rhythm (figure 1) which provides the venue for actions related to the alignment of planning, operations, logistics and intelligence At the end of the day the tasks quality verification and knowledge feedback should be available to the entire C2 Centers staff.

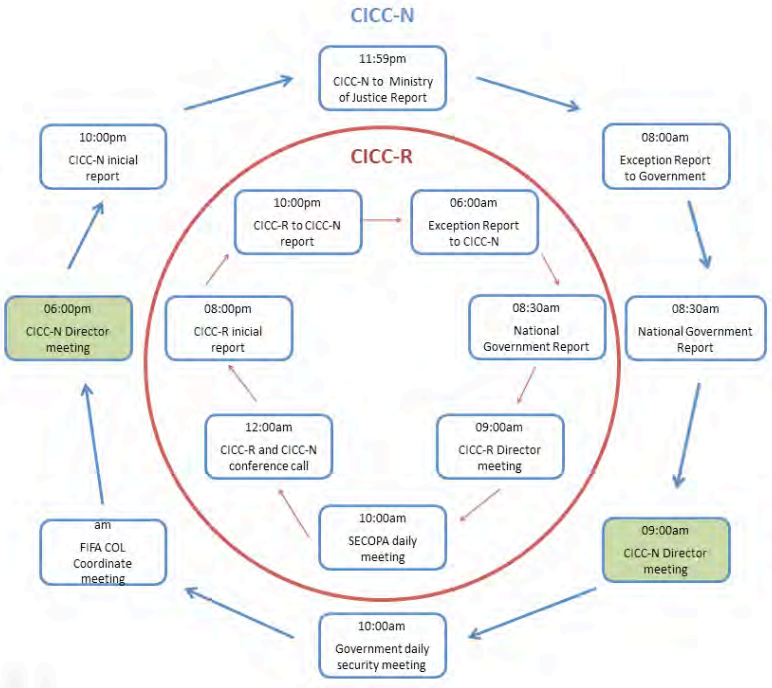

Figure 1. Example of Daily Rhythm of the CICC-RJ in relation to CICC-N (Source: Concept of Use (CONUSO), Rio de Janeiro Department of Public Safety)

Regional Integrated Command and Control Center of Rio de Janeiro

The CICC-RJ is the main element in the coordination of the actions of security for major events in the state of Rio de Janeiro. It integrates public service agencies and monitors and supports security, safety actions taken by federal, state and local agencies, as well as answering emergency calls. The CICC-RJ ensures the national interest information flow to the CICC-N and thus for the federal government. The work done in the CICC-RJ aims to assist law enforcement officials, social defense, civil defense and urban planning, among others. The CICC-RJ is a C2 center, inviting key personnel who work for different government agencies, which has the capacity and autonomy to decide in a risky situation, or to resolve an incident. The main responsibility of the agents that compose the CICC-RJ is to support operational commanders by sharing information and allocating resources as needed.

Organization of the CICC-RJ

Inside the CICC-RJ there is a Coordinator who is responsible for running the center. The coordinator and the agencies shall organize together the necessary activities, operations and logistics to ensure the events well-functioning.

The CICC-RJ does not exclude or limit the necessity for operational and tactical commanders who must perform their roles and legal responsibilities in response to threats and incidents.

Representatives of agencies were allocated in a large room with a Common Operational Picture (COP) display showing: schedule of events, television news, city traffic information and real-time monitoring cameras of public places and subway, trains and ferry stations. The COP is operated by a representative of the Coordination of CICC-RJ. Each agency occupies a desk and those responsible for answering emergencies (Mobile Emergency Service, Fire Department, Civil Defense and Military Police) sit closer to the COP.

Inside the CICC-RJ, communication between the representatives of the agencies is made in person. Each agency has a phone available for internal and external communication, but according to interviewees and the observations made, it is hardly used for internal communication. There is no instant messaging or chat software available to aid communication. There is no standardized means of communication between field agents and representatives of agencies in CICC-RJ.

FIFA Confederations Cup 2013 plan

During the Confederations Cup, the CICC-RJ housed the following agencies:

- **Security**: Federal Police (PF), Federal Road Police (PRF), National Security Force (FSN), Air Defense Command and Control (CCDA), Cyber Defense Centre (CDCIBER), Military Police (PMERJ), Civil Police (PCERJ), Municipal Guard (GM-Rio)
- **Safety**: Civil Defense, Mobile Emergency Service (SAMU), Fire Department (CBMERJ)
- **Transportation**: Highway concessionaire (Lamsa), Train Company (Supervia), Traffic Engineering Co. (CET-RIO), Urban Transportation Office (SMTU), Bridge Concessionaire (CCR / Ponte), Airport Infrastructure Co. (INFRAERO), Transport Agency (Agetransp)
- **Communication**: Telecommunication Agency (Anatel).
- **Public Administration**: Operations' Center of Rio de Janeiro City (COR - RIO), Rio de Janeiro State Chief of Staff, Internal Revenue Service (RF), FIFA Local Organizing Committee (COL).

The Plan of the Confederations Cup featured the detailed mapping of the areas of interest. These areas of interest were stadiums and hotels where the teams, referees and representatives of FIFA were staying, the routes between the hotels and other areas of interest and other events related to the Confederations Cup. The plan also contained the mapping of events of interest. These events were not related to the Confederations Cup, but involved the presence of someone related to the Cup (as players going to slums, parties and so on). Each item mapped received a plan of action aimed to prevent incidents and protect the public directly and indirectly involved in the Confederations Cup. These action plans involved: escort of delegations, blocking streets near the Maracanã Stadium, police reinforcements, mass transportation services, unauthorized radio broadcast monitoring, strategic positioning of the police and public safety agents, intense monitoring by cameras throughout the city, telemetric systems, georeferencing, firearms detection systems, among others.

RESEARCH METHODOLOGY

This article was based on descriptive research aimed to discover and analyze aspects of resilience CICC-RJ. We apply Cognitive Task Analysis (CTA) techniques to understand and study the process of decision making in complex environments (Crandall et al., 2006; Gomes et al., 2009). The research team chose the CTA because this is a study applied to a complex context where events happen in a nonlinear manner and need a systemic view to be analyzed (Hollnagel, 2006). Another fact that led to the choice of CTA is that it prescribes methods to get clues and patterns of actions of each involved individual. This helps identify themes and consequently facilitates the analysis of information. The method comprises three steps: 1) Knowledge Elicitation, 2) Data Analysis and 3) Knowledge Representation.

Knowledge Elicitation

Documentary research was conducted in order to find evidence about the procedures adopted by the CICC-RJ, C2 structure, conflict resolution, agencies operation limits, schedule work, communication (ways, means, procedures, etc.), infrastructure, etc. Documental research also included the database of incidents, planned and executed actions. In this artifact we sought evidence about the planning and execution of actions, schedule performance, the agencies responsible for performing each action, communication, incidents related and unrelated to protests, collaboration between agencies, etc. Finally, information provided by the media such as

newspapers, magazines and videos was included to help the interview preparation.

We used the Critical Decision Method (Klein et al., 1989; Hoffman, Crandall and Shadbolt, 1998; Crandall et al., 2006) to conduct interviews applied to different members of the CICC-RJ. Five interviews were done: three with the representative of the CICC-RJ Coordination, one with the representative of Military Policy (PMERJ), and one with the representatives of the Transport Agency (Agetransp).

The purpose of the interviews was to understand the decision making process that occurred during the protests and participation of the CICC - RJ in the solution of incidents. The interview questions were previously developed by the research team aiming to compare documental evidences with facts. It also aims to fill in information gaps. The audio of all interviews was recorded and they were conducted with the participation of at least four members of the research team. At the time of the interview, one of the team members was chosen as interviewer while others team members made notes of the answers. During the interviews, interruptions were allowed and consequently additional questions were added. The relevant information was transcribed to facilitate data analysis.

Two visits were made to the CICC-RJ installations after the Confederations Cup. The research team made four observations during the Pope's visit to Brazil in World Youth Day 2013. These observations were made by at least two members and sought evidence about the procedures adopted in CICC-RJ, conflict resolution, planning execution, communication (forms, media, etc.) and ways of solving incidents. An observation was made in one of protest simulation at Maracanã Stadium before the start of the Confederations Cup.

Data Analysis

In the data analysis we used three techniques based on Critical Decision Method (Crandall et al., 2006):

- Capsulizing Incidents to reduce the interviews and observations narratives and to capture keys decisions. We used key words as: protest, planning, coordination, cooperation, communication, areas of interest, events of interest, transportation, incident, emergency, among others.
- Cataloguing Cues and Patterns to group cues, patterns and actions that shared some criteria defined by the research team. The cues and patterns founded in this research states about the procedure adopted by the CICC-RJ in solving incidents, inter-agency collaboration, communication between the agency representative and field agents and conflict resolution.
- Identifying Themes was applied in data analysis and cognitive sequences to reflect the flow of activities through time. The themes were: planned events, planning execution, incidents related to the protests, incidents unrelated to the protests, decision making and field action reporting.

Knowledge Representation

The knowledge acquired was represented chronologically in a timeline. The timeline showed the sequence of events in the game Italy vs. Mexico on June 16th, 2013 in Rio de Janeiro. The timeline represents the sequence and duration of events, incidents, actions, perceptions and decisions. It tries to describe how the decision-making process actually happened and communication made among the various agencies involved in the events. Figure 2 is a sample that illustrates the events scheduled during a period of time.

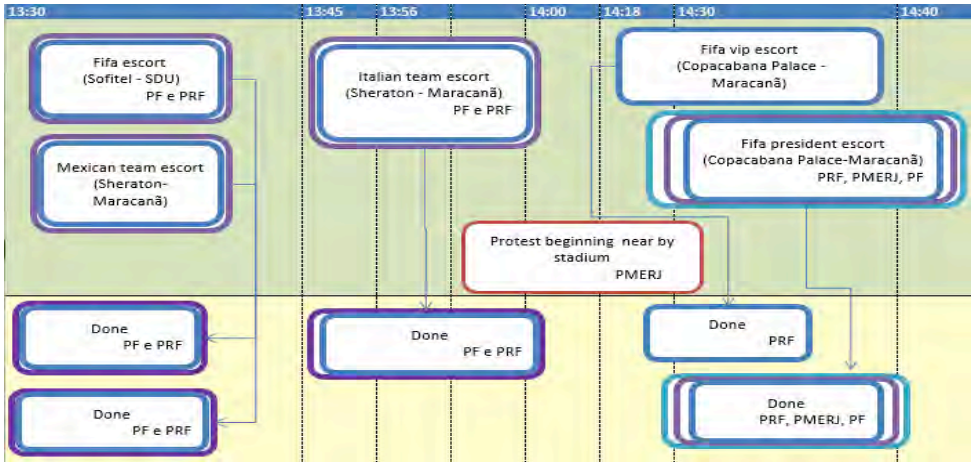

Figure 2. Timeline, June 16th 2013, 1:30pm to 2:30pm

TIMELINE ANALYSIS

The timeline is divided in seven themes:

- **Planned Events** is composed by the information registered in the CICC-RJ databases. It represents the start time of the events planned by the agencies. Events like: Escorts (teams, referees, representatives of FIFA and representatives of the government). The start and end of activities (games, roads blocks, mobilization of security officers, etc.)
- **Realized Events** is composed by the information registered in the CICC-RJ databases and information obtained during the interviews. It is the record of achievement of planned actions.
- **Protest Incidents** is composed by the information registered in the CICC-RJ databases and information obtained during the interviews. It represents the incidents that occurred on the day of the game and are directly related to the protests.
- **Information Request** is composed by the information obtained during the interviews. It is the theme that contains information requests that occurred between the CICC-RJ and field agents during the protest.
- **Decisions** contains information obtained during the interviews. It represents all the keys decisions that the CICC-RJ and the field agents took in the intention of ending the protest.
- **Feedback** contains information obtained during the interviews. It represents the reports done by the field agent to the CICC-RJ after one decision.
- **Other Incidents** is composed by the information registered in the CICC-RJ databases. It represents incidents that are not directly related to the protest like illegal ticket sales, robbery, etc.

The agencies

The timeline contains record of actions taken by 11 of the 21 agencies that compose the CICC-RJ: The concessionaire of the Rio-Niteroi Bridge, Federal Road Police, Federal Police, Telecommunication Agency, Fire Department, National Security Force, Military Police, Transport Agency, Civil Police, the Subway Company and the Local Organizing Committee. The timeline shows that there is a detailed planning of the actions that should take place, but it also shows that there is a fragility related to registration of the execution of these planned actions. The theme Realized Events was very affected because there is very little information available in the database of the CICC-RJ. In interviews it is difficult to obtain accurate information about hours of realization of actions. Examining the database on the other games in the Confederations Cup, it was possible to perceive that this pattern of much information about planning and little information about execution remained. Consequently the CICC-RJ loses its capacity to organizational learning and to improve their plans and operations.

The Protest

The timeline shows that the protest started around 2pm peacefully. The Military Police alerts the CICC-RJ and they decided to keep watch on the protesters, but without interfering in their actions. There are register of apprehensions of gasoline and opportunity weapons like rocks and wood planks. At 3pm the protesters decided to occupy the streets near the Maracanã Stadium. The game was scheduled to start at 4pm. The field agent in charge of the Military Police decided to intervene in the protest and prevent it to reach the Maracanã Stadium. This start a big clash between the two groups and it was possible to find information about people hurt, intoxication by tear gas, depredation and arrests.

In his effort to prevent the protesters to reach the Maracanã stadium, the military police field agent in command "pushed" the protesters to the area near the Quinta D'Or Hospital. There was panic, some people ran for shelter in the hospital and there was vandalism at hospital entrance. The research team was unable to obtain from the interviews what actions were taken by the police to clear protesters from the nearby hospital. It is only known that these protesters were "pushed" to Ceará St., and it ended around 7pm.

Few Collaborative Actions

The timeline also shows that there are few collaborative actions in events that occurred during the protests. From 25 actions represented in timeline to solve the incident, only 2 represents collaborative actions between agencies. Other conclusion that the timeline shows is that there is little communication flow between field agents and the CICC-RJ. The field agent took most of the decisions alone. This study encountered 19 communications actions and only 7 were between field agents and the CICC-RJ.

During the interview, the representatives of the CICC-RJ coordination and Military Police said that they could not get sufficient information from field agents to make decisions. According to them it was necessary informations like: presence of weapons (how many and which type); protest leadership; presence of incapable (children, elderly, handicapped, etc.); If the people who were running towards the train and subway stations sought refuge or were protesters; If there were injured people; etc. For them this information were important to decide whether the stations would remain open and there was a need to shift more police or paramedics to the protest site.

For this paper we used the concept of resilience provided by Hollnagel that states: "Resilience is an organization's ability efficiently to adjust to harmful influences rather than to shun or resist them" (Hollnagel, 2006). In fact it is impossible for organizations to predict all risks, and even if they could, the costs to prevent the risks would derail the business continuity (Woods, 2006). It is necessary that resilient organizations react and recover from disturbances at an early stage, with minimal effect on the dynamic stability (Hollnagel, 2006).

New ways of thinking and doing security and safety actions in Brazil

The CICC-RJ has demonstrated resilience in several points. The fact that it allow this study, including providing documents for research, space for observations and people to interviews are evidence that this center is open to receive external analysis and critiques. In the Brazilian context this is something new. It is common for public institutions expose good results and hide flaws (Hollanda, 1995; Schwartzman, 2007). By opening the institution to receive scientific study and use the result of that to enhance its performance, the C2 Center demonstrates that it is able to continuously improve its methods and therefore be more resilient over time.

The Integrated Command and Control Systems (ICCS) is a point of resilience and a national landmark. It is the first time that the public safety agencies of various states of the federation work in a coordinated way to manage major events and daily operations. This system should serve as a large information network capable of providing a model of risk management and effective response to crises.

The CICC-RJ is a pioneering venture in Brazil and represents a change in the culture of planning public safety. The C2 center is the first time that so many agencies are brought together in a single location. The building that houses the Command and Control Center is a place of easy access, "intelligent", with well distributed and accessible spaces. It is user-oriented and an example of space made to enhance the resilience of the institution (Botterell and Griss, 2012).

The agencies were trained in the use of space and technology available in the Command and Control Center. In the tables of representatives there are guides with basic procedures.

It could be observed that these agencies work together in planning and implementing activities related to major events. We could also see that CICC-RJ has many norms that aims to structure the organization and resolve doubts about planning, areas of activity and limits of each agency, the operationalization of the system, etc. However the normal behavior (how people actually perform their work) usually differs from normative behavior (written in norms). This dichotomy can be perceived when the unexpected protests happened. At that moment the crisis response plan did not work as expected and representatives of agencies in CICC-RJ worked on an *Ad-hoc* mode, without a clearly defined structure for decisions making and without following the crisis management plan. While this has been reported as an unwelcome surprise by the interviewees, the distinction between the normal behavior (realized) and the normative (expected) is common (Woods, 2006; Gomes et al., 2009; Diniz et al., 2005; Hollnagel, 2006). The distinction between normal and normative behavior does not necessarily cause a failure (Dekker, 2006).

Communication

"*The fundamental need for communications significantly constrains the options for both command and control, making communications infrastructure a critical feature of a C2 system*" (Builder et al., 1999).

The communication process in the case study is a factor of brittleness. Through interviews and observations it is

possible to describe that the incident reporting process works as follows: (1) Field personnel call CICC representative through radio or cell phone; (2) The representative verbally informs other agencies' representatives about the incident. We notice that the information is not shared in a structured way among agencies. Some of the agencies that are needed to solve the incident fail to realize that there is an ongoing problem. Consequently, this lack of awareness and dissemination of information may contributes to the increased negative effects (Diniz et al., 2005).

It can also be seen that the field staff is overloaded of work. During the studied event on June 16th, through the timeline (showed on figure 2) we noticed that the special military police field agent was responsible to restrain the protestants from interfering with the football match public flow, to keep the subway stations working, to keep all citizens safe even during the clashes between the police and the protesters and to communicate the course of actions to CICC representative.

The only instruments that most field agents have are their radio equipment, mobile phones and mobile communication equipment with their respective agencies. There is no device for communication with the Command and Control Center and no mobile application to aid communication of plans, performance or incidents.

This lack of communication is a brittleness factor. During the studied events of June 16, most decisions are made by the field staff without CICC consent and this had negative effects.

Trying to push the riot from the stadium, the police "pushed" the protesters to a big hospital. At CICC-RJ it was possible to anticipate this would be happen, as a few citizens started to run towards the hospital for shelter, but it was not possible to warn the field staff and the repressive police action was done in front of the hospital without any regard to the inpatients nearby.

As there was no communication between field agents and the CICC-RJ, the C2 Center could only obtain information from local T.V. and monitoring cameras to understand the complexity of the incident.

Another brittleness is that the C2 center studied does not receive any information provided by citizens. Citizens usually are nearest the place where the incident occurs and can provide crucial information by social networks and mobile devices (Grant et al., 2013). If someone see an incident, he have to call the security / safety agency and the agency must transmit the information to the CICC-RJ.

Knowledge Management

Every day the CICC-RJ performs daily meeting with the representative of all agencies. This meeting aims to discuss the problems of the previous day, talk about the planning of the day and resolve doubts and pending issues. This type of meeting can be considered a point of resilience for the institution (Axelsson, 2006). During the interviews the representative coordinating the CICC-RJ mentioned the importance of daily meeting. One result of these meetings was the creation of a special plan that aimed to protect mass transportation services. However some weak points can be observed at the meeting: (1) there is no obligation of the representatives of the agencies that participates in the resolution of incidents on the previous day to be present at the meeting. (2) It is not obligatory that the agency representative present at the meeting is the one who will participate in the execution of the plan of the day. (3) With the exception of the special security plan for transport services, the research team found no evidence on record and disclose of meeting results.

Another example that could mean brittleness in knowledge management is related to the simulations events for testing the Confederation Cup security. In the security testing observed, a group of military should play the role of rioters, while another group would take care of restraining troublemakers. However the group of troublemakers could be considered quite peaceful. In no time the group clashed with the group that took care of the site security. There was no involvement of health and transportation agencies and the roads near the stadium were not part of the simulation. Very different from the incident that occurred in practice, where clashes between protesters and security forces were quite violent. The simulations should test the worst possible chances and try to take the organization to the limit of their resilience (Dekker, 2006).

Finally, coordination of the CICC-RJ had as a premise train all representatives of the agencies that participate in the Center. However the agencies changes the representatives without prior notice the organization. This fact resulted in the decrease of performance of the institution as a whole, since the untrained representatives did not know the center's processes or technology and they demand a lot of support from the Center coordination.

CONCLUSION

In this study the research team sought to understand the operation of a C2 center, how it worked on the preparation and execution of actions of safety and security while conducting a major sporting event and how it dealt with the unexpected violent protests. We saw that the planning for the Confederations Cup of the studied center was successful since the escort, scheduled events and games happened as expected. There was no need to put in place alternative plans (Plan B). The available infrastructure is high level even compared with those available in the Olympic Games in Beijing (Yu et al., 2009) and London (Armstrong et al., 2011).

We believe that there is still much work ahead especially in relation to crisis management. Although participants of the agencies had some understanding of their roles and possess some shared actions, what was observed was lack of an efficient channel of communication between the agencies and little knowledge management which complicates the decision making process.

In our view, it is extremely important to develop systems capable: to record the execution of action and help tactical and operational decisions; maintain incidents information and resources employed to solve these incidents; and record the communication made throughout the system in order to share it and keep it for possible studies and improvement plans. Specifically, these systems can be designed to support not one, but a variety of Command and Control approaches and, as a result, be better able to cope with unexpected communications and interoperability challenges even during stress situations. This should lead to even fewer failures at C2 Centers.

Command and control centers and agencies that compose it must really believe that catastrophic incidents may occur. It is essential that the preparation is as close to reality as possible. The simulations should test the limit of the resilience of the organization and should not be treated with carelessness.

As future work this research team will propose the construction of the systems aforementioned and continue analyzing the CICC-RJ in major events, specifically in the New Year's Eve 2013/2014, FIFA World Cup 2014 and Olympic games in 2016. The purpose of this analysis is to propose, in collaboration with members of the CICC-RJ, techniques, frameworks, software and processes that are able to increase the resilience of this center.

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