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BIG DATA ENVIRONNEMENTS AND DECISION MAKING: THE TIME TRIAL STAGE OF THE 2017 TOUR DE FRANCE

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Abstract: As demonstrated by Godé and Vazquez (2017), French National Police teams often encounter unexpected events (Godé, 2016) which compel them to make quick decisions. Big data environments can have an impact on their decision-making processes. The research question of this article is: "How are public safety decisions taken in big data environments?" This research focuses on a specific event: the time trial stage of the 2017 Tour de France, which took place in Marseille in 2017. The city of Marseille thus hosted the famous cyclists on July 21st, 2017 during this special stage of the popular annual French cycling race: up to 300,000 spectators were expected. In order to coordinate the numerous police patrols, the decision-makers of the Center for Information and Command (CIC) were able to rely on the set of technologies that constitute their big data environment. This new informational context is exploited by police decision-makers to identify risky situations, reassess a situation when an unexpected event occurs, and secure the operations of the teams on the ground.

Keywords: decision-making, intuition, big data environment, unexpected events, police, 2017 Tour de France.

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In May of 2018, the Orlando Police Department reported that it had been able to arrest a suspect thanks to Rekognition (Dugal, 2018), an artificial intelligence software developed in 2016 by the industry giant Amazon (Amazon, 2016). This system is linked to the network of surveillance cameras installed across the whole urban area. Its purpose is to prevent the malevolent actions of dangerous individuals by exploiting and analyzing the many images caught by all the cameras: the data generated is so massive that such a task would hardly be achievable by resorting only to human resources. This partnership evidences the growing interest of companies and public institutions in big data and its resulting applications. Rekognition's processing capacity is considerable: the system can detect objects and faces, extract text, and set off an alert when a potentially dangerous situation is spotted (Pathak et al., 2018). For example, Rekognition makes it possible to identify up to a hundred people per image in real time, which allows to analyze several billions of images per day (Amazon, 2018).

Integrating the phases of collection, processing and analysis of big data represents an important human and material challenge for a company (Karoui et al., 2014; Vassakis et al., 2018). Big data requires significant computing power to reveal trends and patterns based on a set of information (Dallemlé and Davenport, 2017). It becomes necessary to invest in advanced solutions for massive data processing, also known as "big data analytics": systems that select the relevant data to be processed and transmit a directly exploitable representation of the aggregated elements (Vassakis et al., 2018). Rekognition is one of these advanced solutions. However, many companies do not have the technology necessary to store, collect and process big data. They are therefore forced to analyze manually the data relevant to their activity (Vassakis et al., 2018). It is considered that such companies operate within a "big data environment", which is defined as "a dense and heterogeneous informational environment composed of a set of information systems (and/or technologies that are little or not integrated" (Godé et al., 2019). It includes major volumes of structured and unstructured data, most of it generated continuously.

In a big data environment, decision support technologies play a key role by providing the organization with significant data so that it can make decisions (Assunção et al., 2015; Genovese and Prentice, 2014; Godé and Lebraty, 2013). It is incumbent upon the decision-makers, however, to manually select the relevant data. They must crossreference the information and aggregate them: for example, they can take into account Facebook or Twitter posts, then complement the information by conducting parallel Google searches to obtain a more accurate representation of the situation.

When the decision-makers are experts in their field, the process of selecting and processing the information is generally intuitive (Vassakis et al., 2018). Dane and Pratt define intuition as "affectively charged judgments that arise through rapid, nonconscious, and holistic associations" (Dane et Pratt, 2007). Several theoretical approaches exist that address intuitive decision-making. We shall adopt the naturalistic decision-making model (Klein, 2015), which claims that intuition is based on experience. Intuitive decisions based on exploiting a big data environment thus depends on the decision-makers' ability to analyze but also on their expertise (Janssen et al., 2017).

One of the most critical aspects of big data relates to its effect on decision-making processes, all the more so when the process of information selection is intuitive. The literature on this topic has been considerably enriched in the past few years (Davenport, 2014, 2017; Davenport et al., 2012; George et al., 2014; Van Rijmenam, 2014; Vitari and Raguseo, 2017). Yet most of the recently published works only address this phenomenon with respect to organizations that work with automated processing solutions for big data analytics. Very few focus on the issues that decision-makers are confronted with when they must build massive data collections on the spot, using little or not integrated technological devices.

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The French National Police (PN) is currently facing many changes, including a technological evolution. The institution is increasingly open to big data and to the technologies that make it possible to collect, process and visualize the data. However, it is lagging far behind private organizations (Casey et al., 2019). In the Centers for Information and Command (CIC), the staff's mission is to ensure the coordination of the patrols on the ground, under the authority of a supervisor. Exploiting the big data environment enables, for example, to facilitate the geographical distribution of resources (pedestrian and motorized police patrols) or to reduce criminality by identifying at-risk areas (Casey et al., 2019). As for now, the tasks of collecting and analyzing the available data still remains incumbent on the supervisors and their teams. In such a context, our research question is as follows: how do public safety experts take decisions in a big data environment. This article focuses on expert decision-makers who work in extreme conditions, in the sense that they frequently face unpredictable events and operate under a heavy time pressure: the supervisors of the National Police Centers for Information and Command. The idea is to determine whether the big data environment has an impact on their decision-making processes. Indeed, this new informational environment provides them with more information which, we can assume, could enable them to improve the decisions that will be implemented on the ground.

The first part of this article presents the extreme context in which the National Police decision-makers operate, as well as an adequate decision-making model. The second part describes the methodology as well as the research field within which the study was conducted. The third part introduces the main contributions of this research. And lastly, an answer to the research question is offered in the conclusion.

1. Decision-making and big data environment in an extreme context

Police officers are frequently confronted with unexpected events that require them to adapt their modes of action and the way they implement decisions on the ground. This specificity is characteristic of extreme management situations (Aubry et al., 2010; Bouty et al., 2012; Godé, 2015; Godé and Lebraty, 2015). In an extreme context, decision-makers often face complex and unexpected issues (Rittel and Webber, 1973), whose consequences are difficult to anticipate. Such issues force them to collect additional information in order to identify precisely the situation they are dealing with. Ultimately, this information is what determines the final decision that will be implemented.

The different types of situations encountered by police teams

According to Godé (2015), French National Police teams are generally faced with three main types of situations in the context of their operations on the ground: routine situations, unexpected situations, and crisis situations. The author explains that operators that work in extreme contexts are not always confronted with unpredictable situations. Most of their actions are routine. However, a routine situation can suddenly take a turn to an unexpected situation. The team must therefore be able to deal with the shift from a situation to another, and to trade the standardized decisions framed by procedure that govern routine situations for the flexibility and adaptation needed to respond to an unexpected situation (Godé, 2015). In October of 2020, two police officers are on patrol to monitor an industrial area in the Val d'Oise department (Le Monde, 2020). This is a routine mission for them. During their patrol, they are accosted by three individuals who mistake them for travellers. The police officers then show their professional ID cards but are immediately taken on and pulled out of their vehicle. The aggressors steal their service weapons straight after and open fire. One officer is shot four times. He barely survived after several days in a coma. These police officers were confronted with a dramatic

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shift in a situation, from routine to unpredictable. These shifts force individuals to quickly change their mode of action in order to respond to the new threat faced.

Police officers are subjected to the constant risk of unpredictable events, but they are prepared to respond to it (Hällgren et al., 2018). The execution of an action (even one that seems adapted), can however have negative consequences, or even lead to disasters (ibid.), especially when the patrols are confronted with an individual's dangerous behavior. It is frequently the case when a suspect resists arrest and tries to run away. In June of 2019, a patrol of the Paris Police Department conducted an ordinary roadside check after a bump between two cars. One of the drivers refused to comply and tried to run away. During the chase, the man drove against traffic into the beltway in an attempt to escape the law enforcement officers. He ended up colliding with another vehicle and causing an extremely serious accident: five persons were injured, two of them very severely (Figaro, 2019).

In order to anticipate these events and respond to them, police teams need to be able to quickly and intuitively make sense of the situations they encounter (Weick, 1993). In such cases, the expertise of the decision-makers is what enables them to transform a situation that may be chaotic into a coherent representation (Klein, 1999).

Recognition-Primed Decision model (RPD) and big data environments

The proponents of the naturalistic decision-making approach consider that intuition is based on experience (Klein, 2015). According to this approach, intuition is strengthened as more expertise is acquired (Phillips et al., 2004). Expert decision-makers thus build, as their experience grows, the reflex ability to respond to the situations they encounter. The Recognition-Primed Decision model (RPD), developed by Gary Klein, describes the 4 steps of the intuitive decision-making process of an expert decision-maker operating in an extreme context (Phillips et al., 2004; Ross et al., 2004). The model goes as follows: first, the decision maker detects a problematic situation (step 1), then collects information from the surrounding environment to build a mental representation of the situation (step 2). Then, the decision-maker intuitively identifies analogies between the present situation and other situations encountered in the past (step 3). During that phase, the decision-maker mentally tests the first solution that comes to mind, and anticipates its potential consequences. The decision is ultimately put into practice if it is deemed satisfactory to solve the problem encountered (step 4). This decision making model indicates that experts do not compare different options with one another, but rather intuitively implement a decision that they already applied before in a context deemed similar (Klein et al., 2010). Experts execute a solution that seems to them relevant to the situation they are confronted with, but they find it difficult to explain why the solution appears so evident to them. The additional information that is now accessible through new technology (social networks, surveillance cameras, databases, etc.) is likely to have an impact on the decision making processes of expert decision-makers. A big data environment is not strictly the same as big data per se. A big data environment comprises all the data (social or otherwise) available through web 2.0 applications, but also all the information captured by independent systems and accessible on tablets, computers or phones. Decisionmakers who rely on data from surveillance cameras, get information from social networks, and simultaneously search through the many internal databases of their organization operate within a varied informational context that qualifies as a big data environment (Godé et al., 2019).

The following sections of this article present the methodology of our research, describe the important events that occurred during the time-trial stage of the 2017 Tour de France (TF), and offer a representation of the big data environment that police teams worked in during the cycling

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competition. We will try to determine how this environment enabled the supervisor in charge of the policing apparatus deployed for the sports event to make well-founded decisions.

2. Methodology and field of research

Methodology

During this research, we went back and forth several times between periods dedicated to conducting field investigation, and others devoted to the study of theoretical works related to the issue at hand (Charreire-Petit and Durieux, 2003): the method we adopted is thus abductive reasoning (Koenig, 1993). The investigation conducted within the CIC of the Bouches-du-Rhône regional PN department was made possible after several meetings with the officials in charge of the research division of the Superior National School of Police (ENSP). This investigation was carried out as part of a PhD research and the elaboration of a technical report (Godé and Vazquez, 2017) commissioned by said division. In total, 28 interviews were conducted, including 4 prior meetings, 12 exploratory interviews, and 12 confirmatory interviews. These interviews were carried out individually or collectively, with National Police commanders and captains. The interviews lasted between 45 minutes and 2 hours 26 minutes, with an average duration of 1 hour 17 minutes. Additionally, a day of non-participant observation was conducted on July 22nd, 2017. We were seated behind the supervisor of a public order enforcement room, and therefore could get an overall view of the different operators' work stations.

A thematic content analysis was executed using the NVivo 11 software. Two coding tables were elaborated. The first one, dedicated to the analysis of the information collected in the exploratory interviews, contains a set of themes identified after a first stage of studying theoretical works related to this article's subject. New categories then emerged as the investigation kept going, which led to the elaboration of a second coding table. That second table comprises 4 main themes: (1) the contextual specificities of decision-making situations; (2) the familiarity of the decision-maker with the situation; (3) the information exploited through the big data environment during the decision-making process; (4) the consequences of the intervention. The analysis of the information pertaining to the first three themes provided three conclusions: (1) In a big data environment, the experts are better able to detect a problematic situation or anticipate a change. (2) The information collected by patrols on the ground is systematically cross-referenced with the data exploitable by the CIC's technologies. (3) The big data environment is used to envision fallback solutions for the teams on the ground. These results allow us to suggest an amended version of Gary Klein's RPD model.

Presentation of the CIC of the Bouches du-Rhône regional PN department and during the time-trial stage of the 2017 Tour de France (TF 2017)

The National Police is divided in three levels: tactical, operational, and strategic. The tactical level involves the work of the teams on the ground (pedestrian and motorized patrols), the operational level consists of the action of the different CICs. Lastly, the strategic level refers to the political guidelines. The CIC of the Bouches-du-Rhône regional PN department extends over 3200 square meters and is organized into 9 zones: a command room, an operational support unit, an administrative service room, an emergency call dispatch room, a message processing room, a public order enforcement room, etc. As a commander explained to us: "The current function of CICs is to receive emergency calls, to process them, and to coordinate the interventions." The CIC acts as the connecting link between the tactical and strategic levels, as commander C. highlights it: "The CIC is also the echelon that makes it possible to inform the hierarchy in order to make good decisions."

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When the teams reach the site of an intervention, they are often not in possession of all the information needed to prevent a dangerous situation. This is emphasized by A.: "We are often underinformed during an intervention, for example the officers are not aware of it when they are going to be interacting with an individual who already has a violent record." The informative function of the CIC is thus crucial, because the patrols do not have enough time to search for the relevant information. It is incumbent upon the CIC to collect and transmit it, all the more so during a major scale event.

When a massive event is scheduled, for example a major sports competition or a festive occasion, a substantial security apparatus must be implemented. To secure an event such as the time-trial stage of the TF 2017, nearly all the patrols have to be mobilized. The public order enforcement operations are monitored remotely from the CIC premises, in a room able to accommodate all the staff involved in the event. During a big scale event, the security apparatus is monitored by the supervisor of the command room, who takes over and leads the teams when a significant unexpected situation arises. This is why the only decisions we analyzed in the context of the observation we conducted on July 22nd 2017, were that of the supervisor in charge during the event.

That year, the time-trial stage of the TF was to take place in Marseille. A safety perimeter was set up for the occasion all along the cyclists' route, and strategically placed openings allowed pedestrians and organizers to pass through.

The big data environment used by supervisor of the public order enforcement room

During an event such as the time-trial stage of the TF 2017, the supervisor benefits from a very rich and varied informational environment, as presented in Table 1.

Within the CIC, the supervisor constantly cross-references the information emanating from the surrounding big data environment. The tasks of collecting, classifying, organizing and analyzing the available data is incumbent to the supervisor (supported by the rest of the team). Some technologies generate a stream of information that is difficult to process manually: for example, the supervisor is facing 4 screens that are transmitting up to 16 video streams simultaneously, and must therefore be able to swiftly identify the information that is relevant to the situation at hand.

Development of the TF 2017 event

On July 22nd, 2017, the public order enforcement room opened as early as 7:30 a.m. in order to prepare the set-up of the security apparatus for the event. No less than 20 people were already present.

The first hours of the morning were dedicated solely to the preparation of the security apparatus: executing the handover from the night teams to the day teams, checking the communication channels, and making sure all the authorized crossing points were monitored by patrols. Around 8:30, all conversations in the room came to a stop, and from then on the operators were all focused on their screens. An assistant to the supervisor gave an oral brief: "To all, I repeat one last time, sector 1 and 2, conference 37, and sector 3 and 4, conference 28." By 9:13, all the crossing points seem under control.

Every single problem encountered implies a check of the surveillance cameras. At 9:38, the supervisor noticed that a sensitive crossing spot, in the Bonneterie street, wasn't being monitored by a Municipal Police team. The Municipal Police operator present in the public order enforcement room was called upon to confirm that fact. At 10:03, the teams on the ground reported several unauthorized crossings: people were climbing over the safety barriers to go from one side to the other. The supervisor decided

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not to focus efforts on these crossings, as the race would not start until over another half hour. At 10:30, the Vélodrome stadium opened to the public, and by then, no incidents had been reported.

It was 10:52 when the atmosphere got tense, an increasing number of people were crossing the barriers, and the women's teams warm-up lap began. An authorized crossing point, on the Prado avenue, was not being monitored by a Municipal team, in spite of its strategic location on the cyclists' route: the decision was made to get in touch with the city officials to request additional forces. The supervisor exclaimed: "We're being kicked around!" The tension was palpable in the room, as there had been a miscommunication on this issue: the operators of the Municipal Police reported that this crossing point didn't appear on the map they had initially been given. After consultation, it was finally decided that a few patrols would be removed from their initial missions and reallocated to that site. At 11:14, the heart disease charity race started. The supervisor expressed the wish to have motorized patrols promptly sent in support to the problematic crossing point, but was informed two minutes later that there was no vehicle available: that option was thus dismissed. At 11:31, the publicity caravan set off on the route, and the supervisor informed the room: "To all: caravan departure confirmed!"

Table 1 the supervisor's big data environment



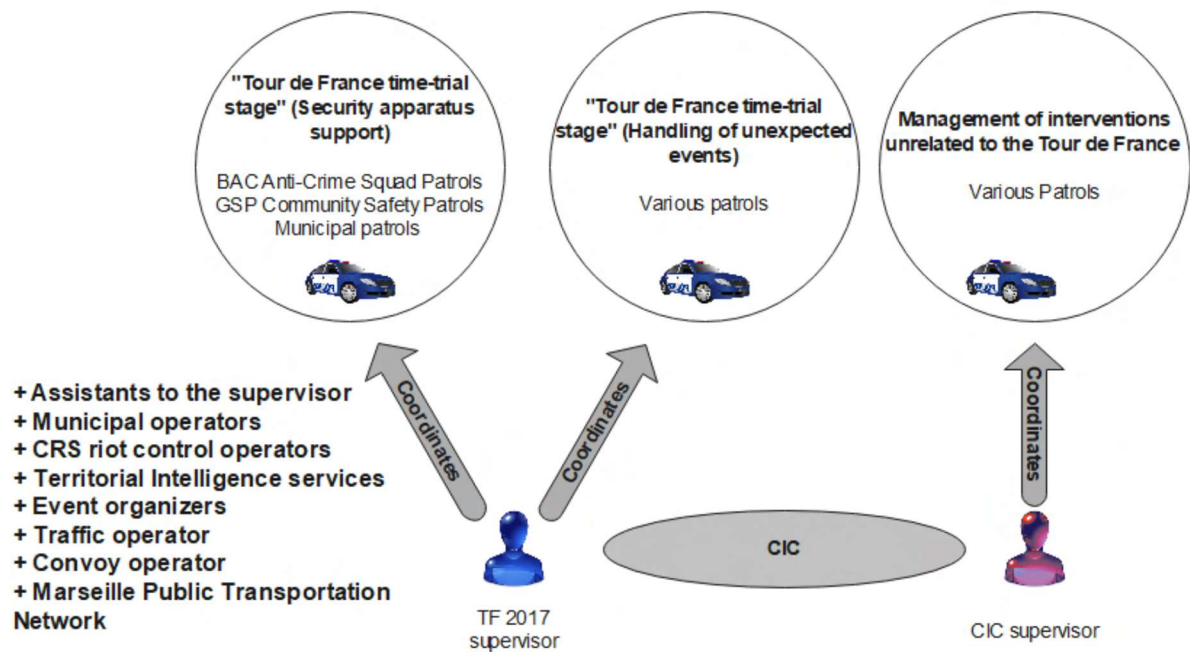
Big data environment – Tour de France 2017

External sources	
BFM TV	Television channel (24-hours national and international news)
Google Map Application	Online mapping service
Cameras of the Urban Supervision Center	Network of 240 cameras
Google Application	Search engine
Social networks (via the territorial intelligence services)	Social media watch, manual monitoring of Twitter and Facebook posts related to the event
Internal sources	
PEGASE Application	Management of current missions and patrol positioning
File of Wanted People (FPR II)	Database containing the identities of wanted and missing individuals in France
File of Reported Objects and Vehicles (FOVeS)	Database containing the license plates of vehicles reported stolen
Criminal Records File (TAJ)	Database containing the judicial records of delinquents and criminals
Human sources	
Territorial Intelligence services	Network of informants on the ground
Marseille Public Transport Network (RTM)	The RTM's tramways are equipped with surveillance cameras
Police Patrols (both pedestrian and motorized)	They include National Police, Municipal Police, and riot control units (CRS)
Informers	Reports from civilians in charge of notifying any incident along the route
Marseille Firefighters	The firefighters work in cooperation with the CIC to cross-reference the information
Gendarmes	The gendarmes work in cooperation with the CIC to cross-reference the information

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After several reports from the population, the supervisor observed that a whole area was completely enclosed by the security apparatus and nobody could exit it. Simultaneously, several stampedes were occurring near some of the crossing points. At 12:05 p.m., the atmosphere was getting tense again in the room: the Prado avenue crossing point remained a bone of contention. As the cyclists go through, all the authorized crossing points must imperatively remain closed, which is why more people tend to cross in disorderly, unauthorized ways. At 12:21, as the male cyclists' warm-up lap started, groups of over 20 people were climbing over the barriers at the crossing point near the flamme rouge (the flag that signals 1km to the finish line). In the room, the terrorist threat was on everybody's mind, and the supervisor explained: "The problem is, if a criminal commits an attack, public officials will ask why the zone wasn't secured!" A patrol arrived at the flamme rouge at 12:34 and managed to put an end to the unauthorized crossings.

Figure 1 Security apparatus implemented, 2017 Tour de France



At 12:56, major disturbances were reported in the Corderie area, where the police had to repel the individuals who were trying to forcibly cross the barriers. The situation was however rapidly stabilized, and a new crossing point was set up to open up the previously mentioned enclosed area. The time-trial race began without any major incident at 1:50. The main issue faced by the teams during the afternoon involved a suspicious package left unattended outside of the area open to pedestrians. At 2:54, the cameras were turned towards the location of the package. The supervisor said: "Good, we have a visual on the bag, let's get the security unit over there". However, no team could get across the road, because the cyclists were going through. It was thus decided to get there via the metro station and send a dog trained to detect explosives. The Marseille Public Transportation Network (RTM) was thus contacted to notify them that the metro tracks would be crossed to reach the bag. At 3:14, a security apparatus was set up around the area by an anti-terrorist "Sentinelle" operator. An individual appeared on the camera screen at 3:25, and started searching through the bag. No one in the room recognized him. His behavior seemed worrisome to the supervisor: "Who is that man?! We need to send a walking patrol to make contact, I don't like his behavior, he is texting, he is squatted down... We must send a team across right now!" The individual was finally apprehended by a pedestrian patrol

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that managed to get across the road. A lengthy interaction ensued, during which the individual kept texting on his phone. The supervisor called out on the radio: "Give me the individual's full identity, and take his phone from him!" After controlling the bag, the team on the ground reported that the individual was a security agent who was trying to reach his superior on the phone to explain why he was there: all danger was ruled out. The rest of the race went by without any incidents. The Territorial Intelligence services reported that ultimately, only 40,000 spectators turned out for the event. Figure 1 presents the security apparatus that was set up by law enforcement.

3. Analysis of the results

Our results indicate that the big data environment was exploited by the supervisor during all 4 steps described by the RPD model: detecting a situation, building a representation of the situation, identifying patterns, implementing a decision. The big data environment allows the supervisor to detect a potentially problematic situation or a shift in context (step 1). When the decision-maker is facing an unfamiliar issue, he searches through his big data environment and cross-references the different sources of information he has access to in order to improve his representation of the situation (step 2). He then collects additional clues, using the big data environment, to test the feasibility of the decision he is considering (step 3). Lastly, we note that in a big data environment, the decision-making process does not end at step 4, the supervisor continues to exploit the available information to improve his decision or envision new strategies.

Step 1: Detection of a situation in a big data environment

As the security apparatus was being set up for the TF's timetrial race, the supervisor used the surveillance cameras to verify that the CRS riot control units were duly positioned along the route and that all the authorized crossing points were being monitored. On several occasions, it was decided to remove patrols from their initial missions in order to strengthen the control of points deemed sensitive by the supervisor, who anticipated potential future issues susceptible to arise from the weaknesses of the security apparatus.

The continuous stream of images provided by the BFM TV channel completes those coming from the cameras of the Urban Supervision Center. The images clearly showed that on that occasion, certain areas of the city were deserted. This was confirmed by a statement made by the supervisor: "The crowd is not very dense, in some of the shots it looks like there are a lot of people, but really, it's not too many, we're good." Very quickly, the supervisor understood that, unless something unexpected happened, the police apparatus that had been set up was more than enough to deal with any incident. He thus decided to focus his teams on the zones most packed with spectators.

In a routine situation, a big data environment allows for the monitoring of the events on the ground and makes it easier to detect an anomaly: the supervisor is in charge of keeping a continuous watch over the evolution of the situation on the ground. Hence the big data environment strengthens the decision-maker's ability to anticipate a sudden shift from routine to unexpected. From being reactive, he becomes proactive (result 1).

Steps 2 and 3: Representation of the situation and assessment of the envisioned decision in a big data environment

As the cyclists were passing through the city, the information was mainly being collected through the network of surveillance cameras. These images enabled to build a mental representation of the situation and to assess the risk level. They could lead the decision-maker to abruptly change his mode of action depending on the evolution of the situation. For example, when major incidents were

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reported in the Corderie area, the decisionmaker initially ordered to shut down that crossing point. After checking the feedback from the cameras installed in the zone, he changed his strategy and requested the reopening of the crossing point. Indeed, the images showed him that the area was much too crowded with spectators: blocking the authorized crossing point could stir tensions. Throughout the stages of the decision-making process, the supervisor was continuously crossreferencing the information reported by the teams on the ground with the information gathered from his technological environment.

During the race, municipal police officers reported the presence of a suspicious package. The supervisor requested a control of the package to be performed. A few minutes later, the bag's owner appeared. Immediately, the images displayed on the camera screen were deemed concerning by the supervisor of the public order enforcement room. He thus requested the individual to be interrogated with all urgency. His objective was then no longer to control the suspicious package, but to quickly apprehend the individual in question. Again, the big data environment was what allowed the supervisor to swiftly change his response to the situation at hand. In the case discussed here, the routine situation had become an emergency situation, and the teams on the ground transformed their approach (Godé, 2015) according to the way the supervisor made sense of the images he was receiving.

A big data environment provides decision-makers with new information that enriches their representation of an unfamiliar situation. This new information is likely to lead more frequently to a change in the selected mode of action (Result 2).

However, it sometimes happens that the supervisor does not manage to obtain some of the information needed to make decisions by exploiting the big data environment. For example, as the cyclists were going through, this issue arose on several occasions, when unauthorized crossings occurred outside of the areas covered by the surveillance cameras. This is an organizational limitation of the big data environment. In such a case, after consultation, the supervisor delegates the decision to a police captain physically present on the ground.

Step 4: Enforcing a decision in a big data environment

Our results evidence a major change induced by the big data environment in step 4 of the RPD model. According to the model initially conceived by Gary Klein, the decision-making process ends when the decision is put into practice. Yet we note that after the decision is implemented, the supervisor can still access his big data environment: the decision-making process is therefore not interrupted. The new information available can be exploited to improve the decision being enforced (the action of the teams on the ground) or to come up with a fallback solution in the event of an unpredictable incident.

The information provided by Google Maps, for example, enables to improve a decision being implemented when the teams receive the order to go to a certain area. During the TF 2017, the supervisor used that application to determine in real time the best itinerary to follow in order to avoid heavy traffic or areas under construction. That technology enables to reduce the time it takes for a team to reach the intervention site (and ultimately, to reduce the time pressure). The big data environment thus allows the supervisor to stay in contact with the operational teams as the decision is being implemented.

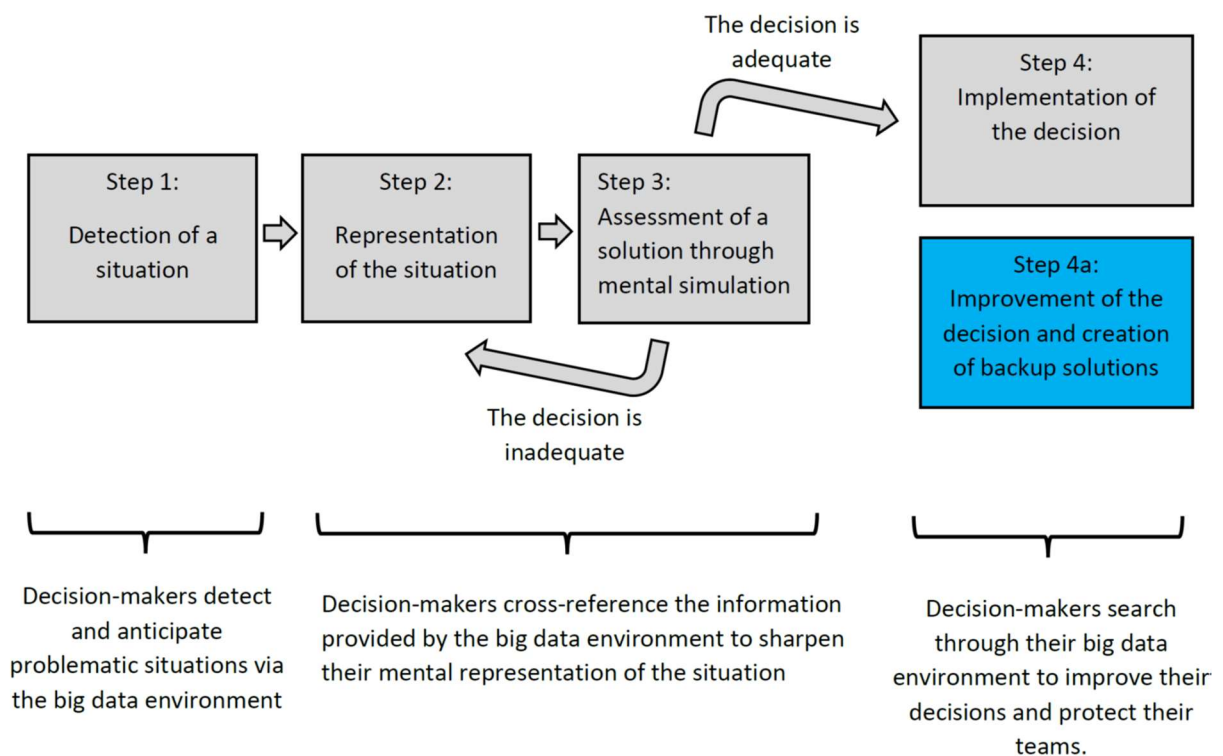
The big data environment, through Google Maps and the surveillance camera management interface, also makes it possible to easily envision a backup plan in case a dangerous, unexpected situation should arise. When the teams are sent to an intervention site in an at-risk area, good knowledge of the topography enables to plan strategic withdrawal scenarios for the police patrols in case they are faced

with violent confrontation. During the TF 2017, when tensions burst between law enforcement and the spectators who were trying to force their way across, the supervisor deployed a team in the affected area. He simultaneously spotted nearby zones that were devoid of barriers or objects that could be used as projectiles, so that his teams could withdraw in case it became necessary. When facing the unpredictable, a big data environment strengthens the decision-maker's ability to come up with backup solutions and to improve a decision already being implemented (Result 3).

A new RPD model adapted to decision-making in a big data environment

Results 1, 2 and 3 lead us to suggest a new version of the RPD model, adapted to decision-making processes in a big data environment. It is presented below in figure 2 and includes an additional step. Step 4a refers to the continuation of the decision-making process during the implementation of a decision. This new step is the phase when expert decision-makers can now improve their decision or come up with fallback solutions to put into practice in case the situation changes dramatically.

Figure 2 RPD model adapted to a big data environment



4. Conclusion

The purpose of this article was to answer the following question: how do public security experts make their decisions in a big data environment? A big data environment favors signal detection, which induces a shift from waiting in expectation to taking action (Results 1 and 2). Furthermore, working in a big data environment leads to a continued decision-making process including when the decision is already being implemented. In particular, decision-makers keep exploiting the available information in order to guarantee the safety of their operating teams (Result 3). Besides, several recommendations directed at the staff of the CIC of the Bouches-du-Rhône regional police department can be formulated in order to facilitate the exploitation of the big data environment. First of all, it is necessary to allocate resources to the tasks of collecting and processing the social data and the data provided by the surveillance cameras: we suggest appointing an agent in charge of keeping such a watch

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(Recommendation 1). Furthermore, it seems essential to us that automated processing solutions be implemented in a medium-term perspective to better exploit the information (Recommendation 2). Several experiments were conducted within the institution, aiming at automated detection of dangerous situations (person on the ground, packages left unattended, firearms, etc.). Whenever a potentially problematic situation is detected, an automated alert could be sent to the supervisors to invite them to perform an in-depth visual check. Finally, our investigation opens the way for new research avenues. Indeed, we noted that, in some contexts, a big data environment can sometimes negatively affect the decision-maker's ability to build a correct mental representation of the unfolding event, and lead to enforcing a decision unsuitable for the situation encountered. Indeed, the newly available data increase the likeliness of being confronted with contradictory or ambiguous information (Fisher and Kingma, 2001). It was the case, for example, when the supervisor noted (via the surveillance cameras), that his teams were having a lengthy interaction with the owner of the suspicious package. He seemed very surprised that the municipal police officers had not confiscated the individual's mobile phone, and sent out several messages on the radio, issuing command after command, without any reaction from his teams. He later learned that the individual in question was simply contacting his employer to explain why he was standing beyond the safety perimeter. The municipal police officers were in possession of that information, while the supervisor wasn't, which is why his orders were not being executed.

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