Artificial Intelligence
An approach for decision-making in crisis management

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Abstract

The interest in crisis management is increasing for some decades now, since researchers and organizations have realized that crises can endanger them severely and that all kinds of organization are potentially under the constant threat of crises. Artificial intelligence (AI) is also in the heart of the attention as some tasks, traditionally occupied by humans, are already replaced by AI agents, and the fast development achieves more and more promising results. As the core of AI, decision-making has been identified, which itself can also completely change the outcome of a crisis. Thus, the idea to explore the junction of these two fields in the light of decision-making processes appeared to be highly interesting.

Therefore, the purpose of this paper is: first, to find out what is really important in decision-making processes in crisis management, second, to figure out abilities and limitations for human and artificial intelligences, and lastly, how artificial intelligence can affect important characteristics of decision-making processes in a foreseeable period of time. Putting all together led to the research question:

*How artificial intelligence can affect decision-making processes in crisis management?*

To guide these efforts, a qualitative method with an interpretivist approach has been chosen. Therefore, crisis experts (managers and consultants) and AI experts (researchers and developers) were interviewed. Also, notes were taken from a conference about artificial intelligence.

As a result, it has been found out that speed and comprehensiveness are two crucial factors when making decisions in crisis situations. Additionally, empirical findings figured out that this approach needs to be extended by the two decision parameters short- and long-term effect as it is not just about decision-making itself, but also about the feasibility and future consequences of decisions made. A model for ‘successful decision-making in crisis situations’ could be developed and the roles of intuition and rationality as well as abilities and limitations were clarified for both, human and artificial intelligence.

Based on this understanding, artificial and human intelligence could have been placed within our model, showing the complement nature of them. Finally, an exploratory answer to the research question could be derived, presented as short-, medium-, and long-term perspectives. Even though crisis management can be expected to be one of the last organizational fields invested by AI, the results show that there are great benefits of applying AI in crisis management, leading in a high potential that AI will change the picture dramatically.

**Keywords:** Crisis management, crisis, artificial intelligence, decision-making, human intelligence, intuition, rationality, emotion, perception, heuristic, experiences
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After an intensive period, today is the day: writing this note of thanks is the finishing touch of our master thesis. It has been a period of intense learning, not only in the scientific arena, but also on a personal level. Writing this thesis has had a big impact on both of us and made us from strangers to friends.

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Moreover, we would also like to acknowledge Markus Hällgren of Umeå School of Business, Economics and Statistics (USBE) at Umeå university as a first instance on the way to find the right subject and to gain an idea how to peak our personal ‘Mount Everest’ of thesis project.

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<th>Description</th>
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<tr>
<td>AI</td>
<td>Artificial intelligence</td>
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<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
</tr>
<tr>
<td>CIA</td>
<td>Central Intelligence Agency</td>
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<td>HI</td>
<td>Human intelligence</td>
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1. INTRODUCTION

The following chapter has the purpose to introduce the research topic. We start by giving an actual example of our main topic ‘crisis management’ before generalizing the issues related with crises and enlightening the topic background in more details. Thereby, we already define key terms, which is from special importance, as we are combining two different fields of research - a technical one with a business one - and thus, there might be unknown keywords for readers outside one of those subjects. Before concluding the chapter with an overview about the structure of our thesis, we are presenting our research gap as well as our research question as the purpose of our work.

1.1. SUBJECT CHOICE

We are two management students carrying out our last year of master at Umeå University. During our studies, we have both developed a certain interest for management and leadership, especially within complex events. Thus, we decided to contribute to the crisis management field after being witnesses of several major recent crises: the Volkswagen’s emission crisis (Jung, Chilton, & Valero, 2017), the Apple’s battery scandal (Malito, 2018) or more recently the Facebook’s data scandal (Griffin, 2018). Crises can very severely affect organizations and we have decided to contribute to this research field with the goal to better deal with these complex events. In addition, we have discovered a common concern for the decision-making issues, which are at the very heart of crisis management (Rosenthal & Kouzmin, 1997, p. 279; Walumbwa et al., 2014, p. 284). Finally, we spoke with a crisis management expert who suggested us to focus on a hot topic within this field, which is the application of artificial intelligence on crisis management. Based on this hint, we decided to combine these three main subjects - namely crisis management, decision-making processes and artificial intelligence - for our thesis project.

1.2. BACKGROUND EXAMPLE

On September 18, 2015, one of the biggest crisis within the automotive industry became official when the United States Environmental Protection Agency issued a notice that Volkswagen has installed a cheating software in their diesel cars, that could protect whether cars were operating under controlled laboratory conditions or if they were actually being driven on roads (Jung, Chilton, & Valero, 2017, p. 1113). On November 2, 2015, a second notice of violation was perceived, but this time Porsche diesel vehicles were burdened. The Volkswagen emission scandal hit the headlines. Vehicles equipped with those “defeat devices” would emit more than 40 times of the emission while running on the road. The goal of the cheating software was boosting the vehicle’s overall performance while ignoring given emission values (Cavico & Mujtaba, 2016, p. 304). As a result, the situation brought and still brings, Volkswagen, the whole automotive sectors, governments and intermediaries, to their limits (Cavico & Mujtaba, 2016).

The consequences are therefore still continuing. Legal consequences, such as civil complaints about false advertising, violating consumer rights, fraudulent concealment, lead to high penalty payments (Cavico & Mujtaba, 2016, p. 306). Volkswagen initially set aside 7.4 billion US Dollars, and now it seems as the scandal could cost Volkswagen even more than that (Cavico & Mujtaba, 2016, p. 307). Moreover, there are practical consequences, such as environmental consequences, of lasting effects on other companies in the auto industry (Cavico & Mujtaba, 2016, p. 308). But lastly, one should keep in mind all the ethical consequences of this crisis situation, which will be even more long-lasting.
consequences as the full impact of the scandal has yet not be seen. It is foreseeable, that huge negative effects on the company’s base, brand, image and sales will continue.

Giving another example, this time affecting the Japanese car brand Toyota, criticized for their slow response to a crisis taking place in 2010. Moreover, they got negative comments due to ignoring and downplaying hundreds of complaints. Toyota’s top management was rarely heard from at the beginning of the crisis which only worsened the public’s perception (Walumbwa et al., 2014, p. 285).

An even longer list of crisis examples exists, as there are even more recent events of organizational crises, terrorism, air accidents, computer hacking, formation of governments, etc. Unfortunately, such events occur with increasing frequency (Hällgren et al., 2018, p. 111) and can cost millions of dollars, cost jobs and can damage reputation.

1.3. BACKGROUND

Based on these examples, it comes clear, that crises are highly salient, unexpected and potentially disruptive events, that can threaten an organization (Bundy et al., 2017, p. 1662). Such environments constitute a special challenge for organizations. It is worth to note that every organization, well-known or fairly unknown, big or small ones, global player or local organizations, are under the threat of crises, which can be either man-made or also from natural reasons (Rosenthal & Kouzmin, 1993, p. 2). In such crisis environments, it is the task of crisis managers to manage and lead the crisis (Cavico & Mujtaba, 2016, p. 307). As the example of Toyota and Volkswagen showed and according to Walumbwa et al. (2014, p. 285), successful crisis management includes especially fast and honest communication with employees and stakeholders and to ensure that the decisions and actions based on them are in line with their message spread. Therefore, managers have to find a way of reaching good, reasonable and satisficing decisions (Simon, 1993, p. 397), which can, in turn, also be implemented in form of actions.

However, it is easier said than done, as decision-making processes are typically characterized by uncertainty, complexity and equivocality (Jarrahi, 2018, p. 1). Especially in uncertain environments, as it is the case in organizational crises, the necessity to make critical decisions becomes a win-or-lose point (Rosenthal & Kouzmin, 1997, p. 279; Walumbwa et al., 2014, p. 284). Decisions need to be done fast because every moment matters in a crisis. Dane & Pratt (2007, p. 33) point out precisely, that there is a trade-off between decision speed and decision accuracy existing. Putting it differently, managers have to match both, quick but also qualitative decisions.

Considering this clash between speed and comprehensiveness, only focusing on rational thinking seems to be insufficient (Jarrahi, 2018, p. 4). Thus, we will focus on the differentiation between rationality and intuition in the context of decision-making. Rational decision-making is thereby defined as the comprehensive following of a sequence of logic steps (March, 1994), containing problem recognition, comprising of alternatives, evaluation and actual choice of the prioritized alternative (Simon, 1993, pp. 394-395). Intuitive decision-making skills are based on experiences stored in the humans subconscious (Khatri & Ng, 2000, p. 60). The latter one will be more deepened by the 4 influential factors, that are perception, heuristics, experiences and emotions, which all together illustrate intuitive decision skills.

According to Banerjee et al. (2018, p. 203), “the power of reasoning and the ability to make better decisions has been the best gift God has bestowed upon mankind”. Humans are intelligent, can recall memorized contents and can base their decision upon them.
However, as the complex Volkswagen example shows, content sometimes might be incomplete (Banerjee et al., 2018, p. 209), due to the limitations of knowledge but also the limitations of our short-term memory (Simon, 1993, p. 397). Simon (1993, p. 397) exemplifies in his article “the difficulty we have of keeping more than one phone number in mind as we go from the telephone book to the phone. But writing came along, and we can write the telephone numbers down, if we are clever enough to think of it. Today, we also have other kinds of help, many of them due to the computer, many of them due to mathematics.” Already in that period of time (1993), the transformation in technology impacting stored knowledge, and thus, decision-making processes became apparent, and the intelligence of technologies is nowadays expanding more and more rapidly (Jarrahi, 2018, p. 2). As humans need more time to gather information, they need automatically more time for decisions (Jarrahi, 2018, p. 2). Thus today, there are semi-autonomous decision-makers in complex, increasingly diverse contexts acting (Jarrahi, 2018, p. 2). Such semi-autonomous decision-makers are part of the engineering science called “machine learning”, which itself is a part of artificial intelligence (AI).

AI can simply be described as the performance of intellectual tasks, traditionally done by human, including the ability to learn, reason, plan, make decisions and to communicate in a natural language (Maini & Sabri, 2017, p. 11). The goal of AI developers is to make machines to think and act comparable or even better than humans (Banerjee et al., 2018, p. 203). In the context of decision-making, the goal is therefore to change semi-autonomous decision-makers into fully autonomous AI agents undertaking decisions. The current AI’s state of the art is already able to respond quickly to disruptions, e.g. in the operation of several manufacturing companies (Ransbotham et al., 2017). Other AI developers achieved to beat an expert in the strategy game “Go” (Maini & Sabri (2017, p. 5), illustrating an example, which will, pared with more recent examples, be mentioned and partly discussed throughout the following thesis at hand.

Especially in the field of supervised and unsupervised learning, both subfields of machine learning, where either just the input (unsupervised) or both, input and output (supervised), is given, the research is already quite advanced (Lison, 2015). When it comes to reinforcement learning, which is the most lifelike form of machine learning, where machines learn by reward maximization (Maini & Sabri, 2017, p. 9) as a newborn child does while growing up (Banerjee et al., 2018, p. 205), fast development will be expected. The expectations on this development are high. However, many organizations are not sure yet of what to expect from AI exactly and how this will fit their business model (Ransbotham et al., 2017). Studies show that less than 39% of all companies have an AI strategy in place yet even though it is foreseeable that AI will have huge implications for management and organizational practices within the next five years. It is interesting to envisage how decision-making processes would have been different within the Volkswagen scandal, when AI would already have been implemented according to the AI developers’ future vision. Thus, the time to identify possible effect is now (Ransbotham et al., 2017).

MacCrory et al. (2014, p. 14) states, “for any given skill one can think of, some computer scientist may already be trying to develop an algorithm to do it”. Walumbwa, et al. (2014, p. 284) noted that the Internet and other technological tools have altered how organizations and society conduct business, but unfortunately, this new ease of access has not eliminated all the barriers to decision-making, especially in times of a crisis.

Based on that gap, we want to put AI and decision-making in the context of crisis management together. Interestingly, two school of thoughts can be identified in recent literature. First, the approach that “AI can extend human cognition when addressing complexity, whereas humans can still offer a more holistic, intuitive approach in dealing with
uncertainty and equivocality in organizational decision-making” (Jarrahi, 2018, p. 1) is existing. This opinion is contrasted by the belief, that humans’ decision skills decrease in uncertain, crisis environments, leading in the necessity to build AI agents that are free from such constraints (Banerjee et al., 2018, p. 210). In brief, it is controversial whether AI can simply cover rational decision-making, or if it can also affect intuitive decision-making processes, and in fact, if it can affect decision-making under crisis situations in the foreseeable next decades.

1.4. PURPOSE

Summing up, there are ongoing crises occurring and no organization is fully safe of the threat. Moreover, the recently “little child” AI is growing fast and will definitely change the picture of how companies work. Especially in a topic of crisis management, it is therefore important to anticipate beforehand the possible effects of such a fast-developing technological progress, rather than to wait until the child becomes adult and will maybe create even more crises, cost even more millions of dollars, cost even more jobs and can damage even more reputation than any crisis by itself already does.

Thus, in order to enlighten the revealing convergence of this recently hot topic of how AI can affect crisis management, we want to start contributing to the literature by exclusively focusing on decision-making processes as an important part of crisis management and as a core of artificial intelligence. We also want to motivate further research in other subareas of crisis management in the light of AI.

In order to explore this interesting linkage, the data were collected through multi case study interviews as well as participating in a conference to gather recent information, as the literature about AI is changing rapidly. Getting a picture about both fields of interest leads in the logical necessity to conduct interviews with two types of experts: (1) artificial intelligence experts, working on the development and applications of this technology, and (2) organizational crisis manager, who both, will in the same time benefit from our efforts. The interview’s goal was to find out what is really important in decision-making processes in crisis management, to figure out which experiences and fears crisis managers have with AI and lastly, how AI’s technology can replace important features of decision-making processes in a foreseeable period of time. Based on the expertise within the two fields of interest, always having the clear purpose in mind, pared with the literature review done by ourselves, our research will be guided by the research question “how AI can affect decision-making processes in crisis management?”.

1.5. STRUCTURE

To guide our efforts, we begin with a literature review, summarizing previous relevant findings and defining key terms such as “crisis”, “crisis management”, “decision-making” and “artificial intelligence”. From this base of understanding, we begin with an explanation of our research method, including the research philosophy, the choice of data collection as well as the analytical method of how to systematically analyze data in order to figure out the findings. Thus, towards the end of this thesis project findings will be presented followed by a discussion of empirical and literature findings. Lastly, a conclusion with the possible limitations and further research recommendations of this research project will be stated.
2. LITERATURE REVIEW

In this chapter, we examine and inspect the literature of the main topics of our thesis. The first main part focuses on crisis management and is divided into four segments: crisis definition, crisis typologies, crisis stages and decision-making. In the decision-making segment, we present first the rational decision-making, followed by the intuitive decision-making (perception, heuristics, experience and emotions), and we finish by introducing leadership and trust in the context of crisis management and decision-making. The second main part puts attention on artificial intelligence. Thereby, we first give a definition of artificial intelligence with its subfield of machine learning (supervised, unsupervised and reinforcement learning), and continue with a presentation of decision-making with AI. The latter part is again divided into three segments: rational decision-making with AI, intuitive decision-making with AI and limits of AI.

2.1. CRISIS MANAGEMENT

When it comes to crisis management, it can be defined as the “actions taken by managers in the immediate aftermath of a crisis” (Bundy et al., 2017, p. 1664). Bundy and his colleagues (2017, p. 1663) underline the fact, that “crisis management over the past 10 years reveals convergence”. In order to successfully understand the area of crisis management, in particular how crisis should be managed, one should start to understand what a crisis actually is. Therefore, we start by defining crisis in the following part of our literature review.

2.1.1. CRISIS DEFINITION

When considering crises and organizational crises, no real consensus about a global definition that could comprise the complexity of this kind of events really exists (Bundy et al., 2017, p. 1662). Fearn-Banks (2010, p. 6) identifies crisis as a salient event with likely negative consequences that might alter the normal operations of an organization and can in some cases even harm the continuation and the survival of the organization itself. Crises are never twice the same, even within the same organization, as “history does not repeat itself” (Gundel, 2005, p. 114). Consequently, the uniqueness of crises makes them difficult to contain in a single definition. However, according to the literature, some recurring characteristics of crisis have been identified from various definitions, which are all more or less related to each other:

**Low probability, unexpected or surprising events** (Weick, 1988, p. 305; McConnell & Drennan, 2006, p. 59; Bundy et al., 2017, p. 1662; Billings et al., 1980, p. 301; Seeger et al., 1998, p. 231). Crisis rareness often creates a “it could not happen here” mentality (McConnell & Drennan, 2006, p. 61), which leads to a lack of prevention and preparation from organizations to deal with crises.

**Salient or high consequence events** (Weick, 1988, p. 305; Bundy et al., 2017, p. 1662). It seems quite logical that some events are considered as crises if they are important events: if a situation is not perceived as significant, and if the impact and consequences are expected to be very small or even not noticeable for outsiders, stakeholders will not consider it as a crisis.

**High demanding in resources** (McConnell & Drennan, 2006, p. 59). Crises require high amount of resources for organizations to be prepared to deal with crises, through “robust planning”, and “trainings and exercises” (McConnell & Drennan, 2006, p. 59). These
activities are really expensive, and combined with the low probability to occur, organizations do not always make decisions to realize them.

**Time pressure or urgency** (Billings et al., 1980, p. 301; Rosenthal & Kouzmin, 1993, p. 1). A crisis situation requires a quick response to get the organization out from the crisis event as fast as possible, since the consequences of a prolonged crisis might have a strong impact on the organization’s future. The main threat with time pressure is that more a potential crisis is perceived distant, the less it seems harmful (Billings et al., 1980, p. 305), but situation can change really fast from a peaceful sea to a storm when speaking about crises.

**Stress** (Weick, 1988, p. 315). As crises are still managed by humans, this kind of unexpected events put people who are in charge of managing these situations under stress, as there is no written solution to solve them.

**Threat to organization’s goals, to the organization image and to the organization itself** (Fearn-Banks, 2010, p. 6; Billings et al., 1980, p. 301; Bundy et al., 2017, p. 1663; Rosenthal & Kouzmin, 1993, p. 1; Coombs, 1995, p. 448; Seeger et al., 1998, p. 231). Related to the salient feature of crises, these events can be harmful for the organization if they last too long or if they are managed badly.

**Triggering event** (Billings et al., 1980, p. 302). Specific situations are considered like crises after the occurrence of a certain event or a change in the situation, meaning that until a certain point, stakeholders do not consider the event as a crisis.

**Uncertainty, disruption or change** (Bundy et al., 2017, p. 1663; Rosenthal & Kouzmin, 1993, p. 1; Seeger et al., 1998, p. 231). During a crisis, organizations’ processes are tested to their limits, and decisions might be made to change the way how to do things if regular operations and procedures do not succeed to solve the crisis. Then, crisis situations represent a singular event for organization, as no one knows what will happen, even after some changes.

The above features are drawing a wide and complex definition of crisis, that embody what crises are in reality - multiple and intricate. Trying to build theories or guidelines that could fit to all crises appears to be impossible. Shrivastava is even mentioning a “Tower of Babel” effect (cited in Bundy et al., 2017, p. 1663), emphasizing that so many different disciplines and cultures are nested on developing theories for crises, that it is impossible to get consensus.

However, most of these features relate to negative and unfavorable elements for the organization. As Bundy and al. (2017, p. 1663) have mentioned, crises are causing change, uncertainty and even disruption in the organization. But it can be an appropriate moment to consider the crisis not only as a negative event, but to consider it as an opportunity to fix the situation sustainably (Billings et al., 1980, p. 315). As a matter of fact, this is dependent on what type of crisis it is and how impacting it seems to be. Whether a crisis can be seen as an opportunity, or simply as a threat, can vary among different types of crisis, as not all crises share the same characteristics. It came clear through the definition of crisis, that crises differ from another, and thus, it is from benefit to search for a possibility to cluster crises at least a bit. Therefore, different crisis typologies will be discussed in the following.
### 2.1.2. Crisis Typologies

Identifying the main attributes that crises share is one important step, but some authors are going further by identifying crisis typologies, allowing a better differentiation. Nowadays, it is one of the most common ways to distinguish crises, even if some critics can be formulated, as crises do not have to be necessarily from one type or the other. It is sometimes almost impossible to clearly separate and distinguish a clear type because crises usually present multiple causations (Rosenthal & Kouzmin, 1993, p. 2). However, these classifications help to better understand how certain types of crises occur, what their main challenges are, and more importantly, how these categorizations can help to handle them (Gundel, 2005, p. 106). All theories about crisis typologies are summarized in the table 1 and will be explained in more detail in the following.

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<th>Crisis typologies</th>
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<td>Hwang &amp; Lichtenthal (2000, p. 129)</td>
<td>Abrupt &amp; cumulative crises</td>
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<tr>
<td>McGinn (2017)</td>
<td>Unfolding &amp; exploding crises</td>
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**Table 1: Summary of crisis typology theories**

To start with the simplest differentiation of man-made (or technological) versus natural crises (Rosenthal & Kouzmin, 1993, p. 2), Mitroff & Alpaslan (2003, cited in Gundel, 2005, p. 108) classify crisis according to their intentionality as either “normal” or “abnormal”. According to them, normal crises are unintentional crises, originated either from natural causes or from system failures, whereas abnormal crises constitutes intentional crises and are the consequence of purposeful evil actions of individuals (Gundel, 2005, p. 108).

Furthermore, some authors have developed a categorization based on a determinant feature of crisis, namely time dimension. Hwang & Lichtenthal (2000, p. 129) have established a binary typology, either abrupt or cumulative crises, based on a theory called punctuated equilibria, originated from biology. This concept is emphasizing that species’ evolution is following a common trend of long stability periods hindered by some sudden and brief period of disruption and change (Hwang & Lichtenthal, 2000, p. 131). Thus, Hwang & Lichtenthal (2000, p. 131) have linked this theory from biology to crises, as they present a similar mode of operation. According to them, abrupt crises are then characterizing events which emerge suddenly and which completely surprise management. Then, there is no linkage of dependency between the amount of time a certain organization has operated without any crisis and its probability to occur. Contrary, cumulative crises are emphasizing events which are developing over time and which ultimately blow...
up. McGinn (2017) is also categorizing crises according to their time dimension by differentiating ‘unfolding’ crises, which are slow-moving ones, like an important lawsuit, from ‘exploding’ ones, like terrorist attacks or disasters.

Finally, even if Gundel (2005, p. 106) recognized that trying to categorize crises can be assimilated to “shooting at a moving target”, since forthcoming events might be different from the present ones, he developed a new matrix classification of four different types of crises. He came up with this typology after realizing that the two criteria – crisis predictability and the possibility for individuals to influence the crisis - are the two most important ones when considering a crisis. There are always debates about the predictability of a crisis afterward, as well as discussions about the possibility for agent to interfere with the threatening event. Thus, according to Gundel’s crisis matrix (see Appendix 1), crisis types can be differentiated into:

- **Conventional crises**: predictable crises on which agents can have an influence
- **Unexpected crises**: managers can still have an influence on these crises, even if they are unpredictable
- **Intractable crises**: agents have no influence on these events, even if they can be anticipated
- **Fundamental crises**: these crises are the most perilous ones, as they are not predictable, and managers cannot have an influence on them.

To conclude, even if classifying crises help to better deal with them, there is no real agreement on which typology is the most pertinent when considering crises, as the world of crises is constantly moving (Rosenthal & Kouzmin, 1993, p. 9), and because crises are addressing multiple realities (Rosenthal & Kouzmin, 1993, p. 4), making classification only temporary valid. Another approach clustering crises, beyond the impossibility to do so based on definition and apart from crisis typologies just discussed, is the multiple stages perspective, which we will be detailed in the following section.

### 2.1.3. Crisis Stages

When it comes to crisis stages, a variety of classifications have been outlined in the literature. However, there is general consensus that crisis have developmental features (Reynolds & Seeger, 2005, p. 49). While Coombs (1999), Bundy et al. (2017), and Reynolds and Seeger (2005) make use of a three-stage models, Fink (1986) outlines the four-stage model, Mitroff (1994) is the pioneer of the five-stage model and Turner (1979) divides crises into six-stage models of development.

Once again, we want to mention the theory of Bundy et al. (2017, p. 1667), referring to the three-stage model of a crisis developed by Coombs (1999). According to them, a crisis can be divided into (1) the pre-crisis prevention stage, focusing on organizational preparedness and how companies can scale down the probability of a crisis, (2) a crisis management stage, during which an organization's members are supposed to take actions immediate aftermath of a crisis, and lastly (3) a post crisis outcome stage, focusing on organizational learning to reduce the likelihood of experiencing a crisis in the future. Almost in line, but several years before and with slightly different names, Reynolds and Seeger (2005, p. 49) divided crises and disasters into prevent-, eruption- and postmortem phase of crisis.

Fink (1986), one of the leading experts and pioneers in the field of crisis management, splits the development of a crisis into four parts: (1) the prodromal stage, defined as to be
the “early warning” period, when an organization can recognize the likelihood of the crisis-to-come, (2) the acute crisis stage, the period when the crisis is per se and the damage has begun, (3) the chronic stage, when the focus lies on analysis, lessons learned and recovery, and lastly, (4) the crisis resolution stage, when the expert includes the period when things finally return back to normal, or in Fink’s words (1986, p. 25) “when the patient is well and whole again”.

Mitroff (1994) developed a model that divides crisis management into five stages: (1) signal detection stage, when signs of possible occurring crises should be identified, (2) the probing and prevention stage forces organizational members to determine ways to prevent a crisis, (3) the damage containment period focuses on the active steps taken following the crisis event, (4) the recovery stage is the period when an organization needs to get back to the normal daily organizational life, and lately, (5) the learning stage, when organizational learning becomes important in order to avoid further crises.

Lastly, Turner’s (1979, p. 381) “sequence of events associated with a failure of foresight” leads to the division into six different stages. His approach is from special interest when referring to crises as human constructions as he assumes a disaster as to be a sociological construction, involving basic disruptions of the social contexts and a deviation from the pattern of normal expectations held in daily life tasks. Even though Turner’s approach (1979) is constructed for disaster, many authors, such as Reynolds and Seeger (2005, p. 49) make use of his six-stage model even for crises. According to them, a crisis can be divided into (1) a notionally normal starting point, referring to initial accepted beliefs and practices existing within an organization, (2) an incubation period, when an accumulation of an unnoticed set of events mismatches with the initial beliefs and practices, (3) a precipitating event period, when the mismatches forces the attention, leading into general perception of stage 2, (4) an onset stage, when the first consequences of the unnoticed set of events become apparent, (5) a rescue and salvage stage, characterized by ad hoc adjustments and lastly, (6) full cultural readjustment, when practices and beliefs are adjusted to fit the newly gained understanding.

All the models reviewed for the crisis stages are summarized in the table 2:

<table>
<thead>
<tr>
<th>Authors</th>
<th>Pre-crisis</th>
<th>Crisis</th>
<th>Post-crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coombs (1999); Bundy et al. (2017, p. 1667)</td>
<td>Prevention</td>
<td>Crisis management</td>
<td>Outcome</td>
</tr>
<tr>
<td>Reynolds &amp; Seeger (2005, p.49)</td>
<td>Prevention</td>
<td>Eruption</td>
<td>Post-mortem</td>
</tr>
<tr>
<td>Fink (1986)</td>
<td>Prodromal</td>
<td>Acute crisis</td>
<td>Chronic</td>
</tr>
<tr>
<td></td>
<td>Signal detection</td>
<td>Probing and prevention</td>
<td>Recovery</td>
</tr>
<tr>
<td></td>
<td>Normal starting point</td>
<td>Incubation period</td>
<td>Onset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Precipitating event period</td>
<td>Recovery and salvage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Full cultural readjustment</td>
</tr>
</tbody>
</table>
Table 2: Summary of crisis stage approaches

Considering all of them, it comes clear, that more stages a model includes, more detailed a crisis and its development are described. The first three models presented above are quite similar - while Fink (1986) enlarges the crisis model by an additional stage of “crisis resolution”, where things already work normally, Mitroff’s (1994) model is additionally focusing on an active possibility of crisis prevention. However, all experts and their models have the idea of a pre-crisis, actual crisis and post-crisis in common. Exclusively Turner (1979) and his six-model crisis approach differs a bit, as his approach can be concluded as to be more focusing on the social construction of a crisis.

In the following work, we want to exclusively focus on Coombs’ three-stage crisis model (1999), due to the reason that artificial intelligence is not that developed in organizational environments yet. Ayoub & Payne (2016, p. 793) even state AI and its related threats are “fanciful” for human. Thus, they conclude, AI “may develop the capacity for general intelligence that matches or even far exceeds humans in its capacity to weigh complex, subjective values”, but just in the “longer term [...] on which estimates among professionals vary widely from 20 years to several hundred” (Ayoub & Payne, 2016, p. 816). The state of the art of AI will be discussed in more detail later on, however, in this point of the thesis project, it is important to figure out that using a too detailed subdivision of crisis stages is almost impossible when focusing on AI. Therefore, it will be concentrated on the “radical and profound changes” (Ayoub & Payne, 2016, p. 794) of AI, coping with pre-crisis, crisis management, or post crisis stages. In this case, decisions have to be made to prevent, solve and avoid crises.

2.1.4. Decision-making under crisis situations

Decision-making is an important part of a manager’s daily life, which came apparent through the introduction example of Volkswagen, as crises often have enduring effects for organizational members such as employees and stakeholders. In crisis situations, the way how managers make decisions is even more important because the decisions’ consequences can be more direct and threatening to an organization than in “normal” organizational settings (Pearson & Clair, 1998, p. 72; Walumbwa et al., 2014, p. 284). To put it differently, in situations characterized by uncertainty and the necessity to make critical choices fast, where every moment matter, as it is the case in crisis situations, decisions can be a win-or-lose point (Rosenthal & Kouzmin, 1997, p. 279; Walumbwa et al., 2014, p. 284). Under such circumstances, time constraints can lead to a lack of information needed to make good decisions, and additionally, in the necessity of both, speedy but also risky decisions (Rosenthal & Kouzmin, 1997, p. 294; Sayegh et al., 2004, p. 180; Pearson & Clair, 1998, p. 66). The longer a manager is searching for an optimal, rational solution, the larger is the risk that the crisis will run out of time and control (Rosenthal & Kouzmin, 1997, p. 294). Dane & Pratt (2007, p. 33) pointed out that there is a trade-off between decision speed and decision accuracy existing. Consequently, there is the necessity to grasp how to make quick but also qualitative decisions.

To tackle the complexity of real-world decision-making, explicit knowledge, rational decision-making skills, and the logical and clear processing of information are of course required (Sayegh et al., 2004, p. 185). However, under crisis environments, only focusing on analytical thinking is insufficient (Jarrahi, 2018, p. 4), because of the necessity to balance both, speed and quality. Out of that reason, it is important also to focus on other factors, impacting the decision-making process, especially under crisis situations.

In the following part, as described in figure 1, rational and intuitive decision-making processes are differentiated from each other. Further on, 4 important factors, which were
identified as crucial by ourselves - (1) perception, (2) heuristics, (3) experiences, (4) emotions - will be discussed in regards to their importance on intuitive decision-making in crisis environments. Lastly, the role of leadership and trust will be pointed out.

Figure 1: Subdivision of decision-making processes

2.1.4.1. Rational decision-making

According to Simon (1993, p. 393), rationality is “the set of skills or aptitudes we use to see if we can get from here to there - to find courses of action that will lead to the accomplishment of our goals”. In the context of decision-making, rational decisions can be understood as decisions which induce such actions - actions that are well adapted to the goals. To put it differently, rational decision-making is the direct result of comprehensive information gathering and processing (Fredrickson & Iaquinto, 1989, p. 516). Thereby it comes clear that rationality in the context of decision-making is related to a process, following a sequence of logic steps (March, 1994). First, it includes the recognition of a problem. The next step comprises thinking which alternatives exist, followed by the evaluation of all alternatives. Lastly, one has to choose among the prioritized alternatives (Simon, 1993, pp. 394-395; Kørnøv & Thissen, 2000, p. 192). That is, a decision is considered to be rational, if the process follows the logic of choosing among alternatives which are expected to best achieve the expected goal (Kørnøv & Thissen, 2000, p. 192).

In crisis situations, it might not be a problem to recognize that there is one, or even more, problems existing, as the crisis itself already constitutes a big problem. However, in complex and uncertain situations, and under time pressure, it seems to be a big issue though to design all alternatives, and to choose among them comprehensively. This is what Simon (1993, p. 396) explains, when stating “it is unbelievable from the beginning that humans always have a conception of what would be optimal in the complex situations”. Humans have to deal with limits in knowledge, limits in the ability to compute and work out the consequences of what we do know (Simon, 1993, p. 397). This is what Simon calls “bounded rationality”, what will be covered in more detail later.

In the literature, there are two schools of thoughts existing. One, arguing for a negative relationship between rational decision-making in unstable environments, and the second one, stating that especially in unstable situations, rationality becomes even more important. The first school of thought is arguing for the abandonment of rational comprehensive processes in dynamic, unstable organizational settings (Fredrickson, 1984, p. 445; Fredrickson & Iaquinto, 1989; Fredrickson & Mitchell, 1984). According to this approach, a comprehensive, slow (rational) decision-making processes would be inappropriate due to the lack of information available, unstable relationships, time limitations and an unpredictable future in such situations (Fredrickson, 1984, p. 445).

Contrary, the opposing school of thought is based on the belief that rationality should underlies the decision-making process especially in uncertain environments. Miller &
Friesen (1983, p. 223) argue that such situations must be analyzed even more carefully, and therefore, require a greater degree of rationality. Also, Ayoub & Payne (2016, pp. 803-804) consider AI as helpful for risk assessment as “humans must choose between probabilistic outcomes on the basis of imperfect information. Modular AI can quantify risk for decision-makers via a data-driven approach. [...] AI can be used to provide recommendations.” In brief, they outline the benefit of AI to consume “vast quantities of relevant [...] literature” (Ayoub & Payne, 2016, p. 804). A couple of years later, Goll & Rasheed (1997, p. 584) confirmed with their empirical study the thoughts of Miller & Friesen (1983).

However, both initial approaches seem to be logical first. At this point, it is important to realize that decisions based on rational processes will not automatically lead to a rational decision (Kørnøv & Thissen, 2000, p. 192). Thus, it is neither black nor white. Empirical research has shown that decision-making processes in practice often do not only follow rationality (Kørnøv & Thissen, 2000, p. 192), rather than humans also make use of an aspiration level (Simon, 1993, p. 396) - forming aspiration of what it seems to be reasonable to expect, based on other influential factors. Jarrahi (2018, p. 4) just recently stated that in uncertain situations, an intuitive style of decision-making may be a helpful addition to decisions based on rationality.

2.1.4.2. Intuitive decision-making

Within intuitive decision-making, decisions arise from the subconscious rather than from just rational roots (Jarrahi, 2018, p. 3). The authors Khatri & Ng (2000, p. 58) pointed out that intuition is not the opposite of rationality, also it is not an irrational process, but it evolves from experiences and learning over a long period of time, making managers able to understand situations more deeply. Thereby, experiences are stored in a human’s subconscious and are accessible through intuition (Khatri & Ng, 2000, p. 60). As an example, Steve Jobs became well-known for making quick intuitive decisions (Jarrahi, 2018, p. 4). Jarrahi (2018, p. 3) defines such “Steve Job-” decisions, based on intuition, as the “capacity for generating direct knowledge [...] and arriving at a decision without relying on rational thought or logical inference”. Jung (cited in Jarrahi, 2018, p. 3) considers this as “intuitive intelligence”, meaning the capacity of human to evaluate alternatives by perception and experiences. According to him, intuition can be understood as a gut feeling or business instinct. Also, Dane & Pratt (2007, p. 33) pointed out that intuition is about the ability to process information effectively and quickly by the influence of gut feelings (Dane & Pratt, 2007, p. 33).

Considering gut feelings, economists may be skeptical that such decision indicators may be inappropriate for organizational decisions. While Khatri & Ng (2000, p. 62) state that “intuition is central to all decision”, Dane & Pratt (2007, p. 41) cut the importance of intuition in the context of decision-making processes back to “appropriate conditions”, where “intuition may be as good as or even superior to other decision-making approaches”. But the authors call attention to intuition as good in some decision-making processes but not appropriate in others (Dane & Pratt, 2007, p. 41). But what are appropriate situations in that context? According to the literature, decisions influenced by intuition are more opportune in unstable environments than in stable ones (Khatri & Ng, 2000, p. 62), in highly complex situations (Dane & Pratt, 2007, p. 33), as well as in situations in which quick decisions are from importance as intuition is characterized as a process of speed (Dane & Pratt, 2007, p. 38; Khatri & Ng, 2000, p. 60). As defined earlier, all these characteristics match with crisis situations.

Putting the fact that the intuitive approach is based on experiences, embodied practices, gut feelings (Jarrahi, 2018, p. 3), and appropriate in crisis environments, together, the
influence of intuition on decision-making can shorten the process by following an automatic performance, allowing experts to ignore the irrelevant information while focusing on critical ones and to decide faster (Khatri & Ng, 2000, p. 61). To conclude, it is not out of reason, that intuitive decision-making processes become more prominent in the management literature as it helps to match with the requirements to make decisions under crisis situations (Khatri & Ng, 2000, p. 57; Sayegh et al., 2004, p. 180).

Perception
One factor of how human decides intuitively is the way how they perceive a situation (Jarrahi, 2018, p. 3). Especially in crisis situations, perception is fundamental, because such an event is inevitably shaped through the viewpoint of an individual. Billings et al. (1980, p. 301) define a crisis in the form of the combination of three variables: perceived importance of potential damage, perceived likelihood of damage and perceived time constraints.

That is, even if an individual or a group of individuals are considering a certain event as a crisis, others might not perceive it in the same way. Organizations are existing through multiple interactions between various groups of stakeholders as Freeman (1984) pointed out within his “stakeholder theory”. Stakeholders do not have all the same role, influence and importance regarding the organization, neither do they share the same perceptions about certain events through which the organization goes (Billings et al., 1980, p. 306). Consequently, a certain extreme and risky event might be considered as a crisis by a certain stakeholder, while another stakeholder will consider it only as a tough situation. From another perspective, what is perceived like a crisis to one part, may be seen like an opportunity to another part (Rosenthal & Kouzmin, 1993, p. 4).

It comes clear, that the individual’s viewpoint is impacting the perception of events, making situations either to crises or not, but moreover, it can also impact the interpretation of these events. Indeed, according to how the manager will appreciate the crisis, it will affect the decision-making process (Sayegh et al., 2004, p. 190). This subjective perspective to consider a certain event, caused by individual perception, might bring decision-makers to develop some heuristics concerning the same situation, which we review in the next section.

Heuristics
According to Walumbwa and his colleagues (2014, p. 286), decisions are shaped by two characteristics: information processing and second, based on those information, decision-making between competing goals. Because of the limitation of how much information humans can process at a time, managers must filter information. That is, what Simon (1979, p. 501) calls “bounded rationality”, meaning that an individual’s rationality is limited to “comprehend and compute in the face of complexity and uncertainty”. This includes cognitive and time limitations, as well as restrictions in the availability of information (Walumbwa et al., 2014, p. 286).

Thus, as discussed above, in a crisis, it is not possible to take the time to figure out which decision alternative might be the best because multiple goals need to be considered (speed, accuracy, frugality, consistency, accountability). Therefore, simple heuristic can be used in order to find a satisfying solution. In the literature, heuristics is defined as “a strategy that ignores part of information with the goal of making decisions more quickly, frugally and/or accurately” (Gigerenzer & Gaissmaier, 2011, p. 454). The approach is based on studies discovering that simple heuristics lead to more accurate decisions than standard rational decisions with the same or more amount of information available. In the
literature, it is also known as the “less-is-more-effect” (Gigerenzer & Gaissmaier, 2011, p. 453). By this, it comes clear that these findings for regular decision-making processes can easily help to understand and improve the decision-making process under crisis situations as ignoring part of the information - either deliberate in regular decision-making processes or due to time constraints as it is the case in crisis situations - can induce more accurate decisions than the theoretically optimal procedure would lead to (Gigerenzer & Gaissmaier, 2011, p. 451; Walumbwa et al., 2014, p. 287).

Also, within the heuristic literature, the “rule of thumbs” is stated quite often. It is an approach where satisfying solutions are derived from personal experiences rather than just from theory. Hereby, experiences are the roots to quickly sort the amount of information available and to base decisions on the prioritization of information (Walumbwa et al., 2014, p. 287). By this, also experiences are from immense importance in the light of decision-making processes.

Experiences

Experiences are critical in the creation of knowledge (Banerjee et al., 2018, p. 205). As Simon (1993, p. 407) exemplifies, Mozart was composing music in the age of 4, but it took him until the age of 17, until he would compose world-class music. Thus, the need of experiences and the application of knowledge, in order to be successful, becomes salient.

In organizational contexts, Giuliani (2002, cited in Walumbwa et al., 2014, p. 289) states that “sometimes when you see someone that has been a truly great leader - whether it’s in business, a great military leader or a great political leader - you think that it’s all intuitive. They must have great natural talent, but the reality is that most often when you analyze that you’ll find that those are things they developed over a period of time” - experiences. This quote underlines that managers can profit from knowledge grounded on experiences, allowing them to make better decisions in crisis situations (Walumbwa et al., 2014, p. 287). Also, Sayegh et al. (2004, p. 186) state, that “manager with experiences may have a better awareness or a bigger repertoire of possible causes”, positively contributing to their decision skills as they are able to faster prioritize information of matter (Sayegh et al., 2004, p. 186). Such experienced based knowledge can be composed through education, training and the involvement in similar events to current situations (Sayegh et al., 2004, p. 185). Moreover, the studies of Sayegh et al. (2004, p. 186) point out, that experiences shape one’s subjective worldview, and thus, in turn, how managers interpret situations and how they built their expectations and decisions up on.

All in all, it can be concluded, that experiences create a “comfort zone”, where managers may lose their fears of managing crisis and fulfill the need of quick decision taking by becoming more self-confident (Pearson & Clair, 1998, p. 70).

Emotions

Even though processes become more emotional and stressful during crises, it was the theory of the last decades that decisions must come from only rational, cognitive processes, where emotions should be best kept aloof. The emotional aspect was often treated as non-essential and ignorable as it was supposed to hamper logical and rational decision-making processes (Sayegh et al., 2004, p. 181). Thus, in both psychology and economics, the role of emotions on decision theory rarely appeared within the last century (Lerner et al., 2015, p. 800).

Later on, a shift in the science of emotions and decision-making theories has raised, seeing emotions as beneficial within the decision-making process (Lerner et al., 2015, p.
As Sayegh et al. (2004, p. 180) mention in their study, “emotions are not only the basis for thinking, but that good judgement and rational thought are largely dependent on emotional signaling”. To illustrate, humans tend to avoid negative feelings and to increase positive feelings. Thus, they make everyday decisions according to an expected positive outcome of their decisions (Lerner et al., 2015, p. 800). However, this is not always the case, and negative feelings result from seemingly wrong decisions. Then, the emotional memory becomes from interests, allowing people to learn from mistakes when taking new, similar decisions (Sayegh et al., 2004, p. 189). Moreover, emotions can act as sensors if emotions seem uncomfortable. In that case, “it is very difficult to articulate the reasons behind these decisions beyond that they just feel right” (Jarrahi, 2018, p. 4). In brief, it comes clear that emotions and decision-making processes are in some way dependent on each other (Lerner et al., 2015, p. 800).

This dependency brought researchers to the analysis of the correlation between decision-making processes and emotional responses to decision outcomes (Lerner et al., 2015, p. 819). The findings show that decisions under the influence of emotions, also called “emotional responses”, are characterized by the state of “awareness, arousal of physical systems and acuity in thinking” (Sayegh et al., 2004, p. 192). Relating it to crisis management, Sayegh et al. (2004, p. 192) give a vivid example that managers under crisis situations can make better and faster decisions “like an athlete who gets psyched up for a big game or match”, as they experience a sense of frenzy and urgency. Thereby, managers remember emotions associated with past experiences instead of recalling all details and contexts of previous situations, helping them to give a basis for fast decision-making based on previous experiences (Sayegh et al., 2004, p. 193). In the literature, this exceptional state of emotions is often named as “emotional energy”, exactly referring to the ability of managers to quickly access knowledge, experiences and deep down stored emotions to base the decision on them. Thus, this emotional energy can be understood as the connection between knowledge and intuitive decision-making, which is necessary especially in crisis situations where fast and good decisions are vital (Sayegh et al., 2004, p. 192).

In sum, it can be concluded, that “human judgement of facts is influenced by emotions” (Banerjee et al., 2018 p. 209). But, effective decision-making requires emotional and social judgement and intelligence (Jarrahi, 2018, p. 6), by making good and quick decision-making, especially vital under crisis situations in organizational settings, possible (Sayegh et al., 2004, p. 196).

2.1.4.3. The role of leadership on decision-making processes

When it comes to social intelligence, the role of leadership should not be overlooked. Leadership is, as well as crisis, difficult to define as it is complex and situational (Summerfield, 2014, p. 252). However, there are a bunch of definitions existing in the literature, summarized in table 3.

Maylor (2010, p. 268) defines leadership as “the quality of obtaining results from others through personal influence”. Also, Reicher et al. (2005, p. 554) point out, that effective leadership relies on an identity-based relationship between leaders and followers, where the fit of prototypicality is from value. Kotter (2000) and Sorensen et al. (2010, p. 1) put the focus on coping with change positively, especially non-incremental change. When considering the purpose of leadership with a special focus on change, Immelt (2013, cited in Summerfield, 2014, p. 252) also states that “great leaders drive change”. All in all, when remembering that crisis causes change, it is from priority to know about the relation of leadership and successful managing change. Taking the other definitions into account, it is clear, that so far, successful leadership includes personal relations, influencing others.
Contrary, management is defined as more knowledge based and task-related (Maylor, 2010, p. 268). Drucker (cited in Maylor, 2010, p. 266), puts it into a nutshell when stating “management is doing things right, leadership is doing the right things”.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maylor (2010, p. 286)</td>
<td>“The quality of obtaining results from others through personal influence”</td>
</tr>
<tr>
<td>Reicher et al. (2005, p. 547)</td>
<td>“Leadership is a vehicle for social identity-based collective agency in which leaders and followers are partners”</td>
</tr>
<tr>
<td>Kotter (2000)</td>
<td>“The fundamental purpose of leadership is to produce useful change, especially non-incremental change”</td>
</tr>
<tr>
<td>Sorensen et al. (2010, p. 1)</td>
<td>“Leadership is successfully creating positive change for the common good”</td>
</tr>
</tbody>
</table>

**Table 3: Summary of leadership definitions**

Trust

When considering that leadership helps to control change caused by crisis situations successfully, mostly by intact interpersonal relationships, the role of trust should be illuminated. Trust can be examined by looking at trusting relationships (Natorski & Pomorska, 2017, p. 56), as they are the factual proof of trust. Thereby, three main elements can be observed: respecting colleagues’ vulnerabilities, being able to delegate tasks even to the lower levels of the decision-making chain, and correctly sharing information. Moreover, trust can also be seen as an individual’s acceptance to rely on another individual, with the assurance that the latter individual is competent, open, concerned and reliable (Mishra, 1996, p. 5).

When considering crisis, trust is an even more important matter to care about, as it plays a significant role in the context of difficult situations (Natorski & Pomorska, 2017, p. 67). To illustrate, in some cases, trust can be a factor for decline in organization (Mishra, 1996, p. 2), because a lack of trust will decrease the productivity and the quality of the work (Sabatier, 2014, p. 3), as actions are not properly implemented. Such a decrease will generate even worse consequences during crises. In order to avoid, trust is necessary in both directions: between decision-makers and subordinates (Mishra, 1996, p. 6). Sabatier (2014, p. 3) calls it the “cycle of trust”, which is illustrated in figure 2. Thereby, managers will trust their subordinates mainly for their competence to apply decisions, while subordinates will trust their leaders for their capacity to make good decisions.

In sum, trust as an important part of leadership, can influence decision-making processes positively, especially in crisis situations, by allowing a quick implementation but also delegation of decisions (Rosenthal & Kouzmin, 1997, p. 294).
2.1.4.4. Decision-making under crisis situations - A summary

Concluding, decision-making processes under crisis situations should be based on both, rationality as well as intuition (Khatri & Ng, 2000, p. 77). The latter one is personal biased by the 4 factors (perception, heuristics, experiences and emotions) discussed above. At this point, it is from matter to realize, that those 4 influential factors cannot be separated in total, rather they are linked and partly overlapping. According to Walumbwa et al. (2014, p. 287), by understanding the importance of the combination of rational and non-rational influence factors on decision-making, one can strengthen the reliability and mitigate potential risks from the decisions made, what is even more important in the case of crisis situations.

Moreover, it became salient, that leadership plays an important role when coping with difficult, uncertain situations. Especially the role of trust seems to be important in order to implement decisions in the context of crisis management.

Based on the knowledge gained within the crisis management part, it is the question, whether technology, i.e. AI agents, which have already replaced a lot of tasks traditionally occupied by human (Maini & Sabri, 2017, p. 8), can also affect decision-making processes in crisis situations? As Simon (1993, p. 407) stated years ago, “we can increasingly make aspects of expertise automatic, through [...] new artificial intelligence tools that are based directly on this psychological knowledge”. “Computers as we know are very fast [...] the human mind is a very slow device” (Simon, 1993, p. 399). But will AI really be capable to fulfill the requirements to manage uncertain, threatening situations, as crisis are, properly? How will AI affect decision-making processes in crisis situations?

2.2. ARTIFICIAL INTELLIGENCE

First of all, we should try to understand what AI is. The intelligence of homo sapiens to understand, apply knowledge and improve their skills by their own has played an important role within the human evolution (Thomas, 2017). Human intelligence leads to a lot: today, people can drive from cities to cities, people can easily fly from one continent to another, they can communicate via smartphones and internet across the world. The technological development, driven by humans, is enormous. However, already in the year 1991, Salomon et al. (p. 8) proved with their empirical study, that it is not just human intelligence making the world more technological advanced, but that machines can be intelligent as well and thus, can make people more intelligent. The most obvious case is that machines offer humans an additional memory, where people can store data (Witten
et al., 2017). But there are far more complex applications of intelligent machines, including performance of mathematics, logic, philosophy, linguistics and decision theory (Maini & Sabri, 2017, p. 9). This technological development, called “artificial intelligence”, is one of the most prominent fields in science and engineering (Russell & Norvig, 2010, p. 1) - the intelligence of non-human that can perform tasks as human can do, and which are as intelligent as human (Thomas, 2017).

Even though the research within this field is not new, “after a couple of AI winters and periods of false hope [...], rapid advance in data storage and computer processing power have dramatically changed the game in recent years” (Maini & Sabri, 2017, p. 3), making AI to a recently hot-topic. When considering that nowadays, more and more technological systems such as robots and/or computer systems, have already replaced tasks traditionally occupied by humans, it is now time to understand how machines think and how it can affect our future life (Maini & Sabri, 2017, p. 8). Giving some examples, in the year 2015, Google trained an AI agent being able to answer questions, discuss morality and express its opinion (Maini & Sabri, 2017, p. 4). Other AI developers achieved to beat an expert in the strategy game “Go”. Maini & Sabri (2017, p. 5) make this real progress, to train a machine to process such a complex game, clear, by comparing that Go has $10^{170}$ possible board positions, whereas there are only $10^80$ atoms existing in our universe. The immediate escalation of abnormal results from medical diagnostics of cancer patients is an example where AI is already used in the health-care industry (Maini & Sabri, 2017, p. 7). Lastly, there is the huge progress in the automotive industry. Here, for instance, a driverless AI car, called “Stanley” caught the news, when finishing the 132 miles long course through the Mojave Desert of the DARPA Grand challenge (Russell & Norvig, 2010, p. 28). Thomas (2017) enlarges the list of AI capabilities by the ability to generate art, processing tons of data and getting accurate timely information and there are even more examples existing.

2.2.1. Definition

By now, it is obvious that AI is about something highly technical, maybe also something unimaginable and fancy, but clearly something which will impact our future in some way (Maini & Sabri, 2017, p. 10). However, there is no real consensus about a real definition for AI (Russell & Norvig, 2010, p. 28; Thomas, 2017). On the one hand, this is due to the reason that AI includes so many fields (Russell & Norvig, 2010), on the other hand, this is caused by the fast development within this technological field (Maini & Sabri, 2017). To illustrate, when considering the development of mobile phones towards high qualitative smartphones, it is obvious, that it is almost impossible to define such a quick developing science as the technology's next goals are changing rapidly. However, several definitions found in the literature can be pointed out.

Russell & Norvig (2010, p. 2) brought in their book “Artificial Intelligence: A modern Approach”, which is cited more than 33,000 times, together the main definitions existing in the literature. According to them, they can be differentiated according to their goal of AI:

- **Thinking as a human**: “[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning …” (Bellmann, 1978, cited in Russell & Norvig, 2010, p. 2).

- **Acting as a human**: “The art of creating machines that perform functions that require intelligence when performed by people” (Kurzweil, 1990, cited in Russell & Norvig, 2010, p. 2)
- **Thinking rational:** “the study of mental faculties through the use of computational models (Charniak and McDermott, 1985, cited in Russell & Norvig, 2010, p. 2)


Maini & Sabri (2017, p. 9) specify that AI is “the study of agents that perceive the world around them, do plans and make decisions to achieve their goals”. In other words, the field of study “describes machines doing tasks traditionally in the domain of humans (Maini & Sabri, 2017, p. 10).

Negnevitsky (2005, p. 2) describes AI as “a science to make machines do things that would require intelligence if done by humans”. 

Thomas (2017) just recently defined AI as a non-human intelligence, that should have the ability “to learn, represent knowledge, plan, take decisions under uncertainty, communicate in a natural language and use these skills towards common goals”.

In sum, even though the definitions show different emphasis, it can be concluded, that AI is all about the performance of intellectual tasks, traditionally done by human, including the ability to learn, reason, plan, make decisions and to communicate in a natural language (Maini & Sabri, 2017, p. 11). With the current state of the art, the literature differentiates between “weak AI” - the ability of a non-human to be intelligent enough to solve a specific problem - and “strong AI” - the ability of non-human to be as intelligent as a human. While recent technology is quite advanced within the field of weak AI, AI developers prognose further development for strong AI in the next decades which “will shape our future more powerfully than any other innovation this century” (Maini & Sabri, 2017, p. 10).

As mentioned previously, AI is a broad research field, and it is difficult to put the topic into a nutshell. Therefore, it makes sense to narrow down the topic, as the literature already did. In the following the subfields, as illustrated in figure 3, machine learning, and even deeper, supervised, unsupervised and reinforcement learning will be considered in more detail.

![Figure 3: Subdivision of Artificial Intelligence and Machine Learning](Marini & Sabri, 2017, p. 9)

### 2.2.1.1. Machine Learning

According to Thomas (2017), machine learning is a subfield of AI, where intelligent algorithms are created, which can actually learn from given data. Robert (2014, p. 1) defines machine learning a bit more detailed as “a set of methods that can automatically detect patterns in data, and then use the uncovered patterns to predict future data, or to
perform other kinds of decision-making under uncertainty”. To exemplify, in normal programming, a program produces an output to a given input. Here, the algorithm actually solves a clear task (Thomas, 2017). Different from that, in machine learning, programs will generate codes and identify patterns without having explicit pre-programmed models, so that the program will be able to predict future data from actual available data (Maini & Sabri, 2017, p. 9; Thomas, 2017). In brief, the goal of machine learning is to enable machines to learn on their own (Maini & Sabri, 2017, p. 9). Within this field, different subfields are existing, which are also presented in the figure 3 above.

Supervised learning

Supervised learning is one part of machine learning. Thereby, the starting point is both, a given input and a given output (Lison, 2015). The goal is to make the computer finding patterns in data through regression and classification and to build heuristics based on them (Maini & Sabri, 2017, p. 16), meaning that the machine actually remembers the patterns and learn from them in order to apply its knowledge for future tasks. Sometimes, a machine achieves to solve the given example well, but it performs poorly when applying it to new data. This phenomenon is called “overfitting”. Contrary, supervised learning is successful, when the machine is able to generalize and abstract the identified patterns to new data. Simplified, supervised learning can be defined as “learning from examples” (Lison, 2015). A classic example for supervised learning AI is a weather forecasting program, which will base its predictions on data from former projections (Banerjee et al., 2018, p. 206). More examples, such as decisions about creditworthiness, will be discussed in the finding part later on.

Unsupervised learning

However, sometimes the output is unknown, and simply the input is accessible (Lison, 2015). In this case, unsupervised learning becomes important (Thomas, 2017). The starting point is input data, whereas the goal is to recognize patterns by identifying correlations, clustering data into groups and to reduce dimensionality through compression (Maini & Sabri, p. 55; Lison, 2015; Banerjee et al., 2018, p. 205). This AI agents are learning by doing mistakes, since there is no previous data available (Banerjee et al., 2018, p. 205). An example for unsupervised learning is the segmentation of a population into smaller groups with similar values or habits, that can for instance be useful for advertisement company in order to reach their target market with appropriate advertisement (Maini & Sabri, 2017, p. 55). Moreover, unsupervised learning is used for image processing (Maini & Sabri, 2017, p. 56). In brief, unsupervised learning can be summarized as “discovering underlying patterns” from given input data (Lison, 2015).

Reinforcement learning

Finally, reinforcement learning is the most complex and also most lifelike form of machine learning, dealing with the situation when the “correct” output is unknown (Lison, 2015). In this case, the agent is supposed to solve real world problems, deciding how to act and to perform tasks in an uncertain environment (Maini & Sabri, 2017, p. 81, p. 88). The only thing how to learn while interacting with an uncertain environment is to measure the quality of an output as a result to a given input and to reward the agents, negative or positive, dependent upon (Lison, 2015; Banerjee et al., 2018, p. 206). Based on the agent’s goal of reward maximization (Maini & Sabri, 2017, p. 9), the agent gains its own experiences in the environment by receiving inputs, trying out actions and receiving rewards as an answer (Lison, 2015). This method can be compared with the concept to not give a student the correct solution immediately, rather the idea is let the student find the solution by himself in order to maximize the learning outcome (Banerjee et al., 2018, p.
2.2.2. **Decision-making with AI**

Even though it is from importance to slightly understand the technique and idea behind AI, built on the gained expertise, we now want to come back to our topic of “How AI can affect decision-making processes under crisis situations?”. As it should be clear by now, AI has already penetrated organizational processes and the technologies within this field are expanding rapidly. In the context of decision-making under crisis environments, semi-autonomous decision-maker agents already act in increasingly complex and uncertain contexts, helping human to make better decisions (Jarrahi, 2018, p. 2). As a result, the already ongoing transformation in decision-making leads to a growing fear, that machines will soon replace many humans in decision-making (Jarrahi, 2018, p. 1).

In the literature, there are two opposing streams existing. While Banerjee et al. (2018, p. 209), states that, due to the fact that” critical decisions need more time made by human”, and the “decline in the strength of decisions making in humans when they are in the state of shock” (Banerjee et al., 2018, p. 210), as it is the case in crisis situations, AI agents should be especially used in critical situations. Also, Polonski (2018) hooks up with the opinion, while arguing, that in most of the cases, AI is better to predict than humans (Polonski, 2018). Contrary, Jarrahi (2018, p. 7) argues, that AI is better for complex decision-making, but human still outperforms smart agents in uncertain and equivocal situations, as it is according to the definition the case in crisis situations.

In order to get a better picture of how AI already impacts decision-making processes, especially in the context of crisis management, the same differentiation of rational decision-making and intuitive decision-making will be discussed in the following - this time with a special focus on AI.

2.2.2.1. **Rational decision-making with AI**

When it comes to rational decision-making, AI has started to play an important role (Banerjee et al., 2018, p. 207). When remembering the explanation how decisions are considered to be rational, namely, if the process follows the logic of choosing among alternatives with the goal to best achieve the expected outcome (Kørnøv & Thissen, 2000, p. 192), and the goal of AI, stated in figure 3, to “design an intelligent agent that perceives its environment and makes decisions to maximize chances of achieving its goal (Maini & Sabri, 2017, p. 9), it appears, that AI is recently developed in order to base decisions on logical rules by using algorithms (Banerjee et al., 2018, p. 207) - on rational decision-making. Banerjee et al. (2018, p. 207) underlines this by arguing, that “the more influence technology has the more we become accurate with our decisions”. Moreover, Pomerol (1997, p. 4) states, that agents are expected to use the same rationality to think, judge, and finally decide. As a matter of fact, the large majority of AI agents are for now considered as ‘weak AI’, which implies that they are specifically designed to answer a single, limited and identified problem and to draw a particular conclusion (Thomas, 2017; Banerjee et al., 2018, p. 203). In this way, their decision-making freedom is totally controlled - decisions depend on either statistical supervised or unsupervised learning (Banerjee et al., 2018, p. 204).

Chamorro-Premuzic et al. (2018) compare AI’s state of the art with the ability of what we call individual’s “hard-skills”. For example, all the fields needing the review of massive amounts of documents and data gradually see AI taking a bigger role in their processes, like the banking sector, the law sector, or the pharmaceutical sector (Terrand,
2017). In this way, a layer’s firm called BakerHostetler has acquired Ross, an IBM AI from the Watson project, in order to deliver the most appropriate response to any question formulated by layers, by seeking in tons of legislation files saved (Terrand, 2017).

2.2.2.2. Intuitive decision-making with AI

As mentioned earlier, when organizations are facing uncertain situations, an intuitive style of decision-making can be helpful (Jarrahi, 2018, p. 4). The belief, that AI is just valuable for rational decision-making, has nowadays already been revised as agents can have other motives and influences to make decisions (Pomerol, 1997, p. 4). It comes clear, that AI has been endowed with more sensitivity and subjectivity (Pomerol, 1997, p. 4), which we mentioned earlier as a key for taking decisions, especially within complex events. Thus, it seems logical to assign a certain autonomy to AI for taking decisions.

Considering heuristics within the field of intuitive decision-making processes, available information is coming massively from various sources and decision-makers have the difficult task to filter, select and prioritize them (Agrawal et al., 2018). This complexity is embedded with the increasing development of new technologies and social networks (Lauras & Comes, 2015, p. 287). Thereby, AI agents seem to be the perfect solution to compute quickly these diverse and numerous amounts of data, by taking into consideration the most relevant information needed to make the decision (Lauras & Comes, 2015, p. 287).

The example of the successful win of the AI agent playing the strategic game “Go” against the most successful human within this field, perfectly underlines the current development of AI in regard of intuition as “the game is played purely by intuition and patterns from past experiences" and not by strict rules and rational decisions (Thomas, 2017). However, AI’s state of the art within reinforcement learning is still not advanced enough to perform better in the face of intuitive decision-making than human in total (Jarrahi, 2018, p. 4). But “strong AI” or “artificial general intelligence” - agents designed to resemble as much as possible to humans, in order for them to act, think and behave like humans would do - are in the focus of AI developers. They forecast, the ability of AI agents to take decisions under uncertainty (Thomas, 2017).

All in all, it comes clear that AI can already support or even replace rational decision-making processes traditionally made by human. Moreover, single examples show, that AI development within reinforcement learning is fast, and that strong AI is expected to influence our future. However, it is still unclarified which school of thought will be more reliable. With our qualitative analysis, we will therefore help to contribute to clarify the opposing streams in literature - namely, whether AI should/can affect decision-making processes under crisis situations in foreseeable decades, where both, rational and intuitive decision-making ability are required, or if AI will only be valuable for decisions made in stable environments, where they are mostly based on rationality.

Before introducing our methodology, as well as presenting our findings, we want lastly spent effort on the literature findings about known limitations of AI in decision-making processes.

2.2.2.3. Limits

Even though, single organizations have started to replace human fully - in the board of directors of an investment firm in Hong-Kong called Deep Knowledge Venture, one of the member is an AI agent and his voice for the votes possesses the same value than the human members (Terrand, 2017) - AI is still seen critical due to its limitations.
The most important limit recognized by scholars is concerning trust issues towards AI, either by misunderstanding, by suspicion, or even fear (Ransbotham et al., 2017). The way AI is making decisions is most of the time too complex for most people to appreciate it, as informatics is not something they are used to (Polonski, 2018). It has been showed that humans are more inclined to commit and collaborate with new technologies if they have a clear understanding on how these agents analyze information and make decisions (Jarrahi, 2018, p. 6). The mistrust regarding AI will increase with the degree of importance of the tasks assigned to the AI. To illustrate, the more AI gets autonomy and responsibility, the more people will feel concerned about the relevance and the accuracy of decisions made by machines. The fear produced by AI is also linked to the fact that strong AI type is supposed to be able to improve itself automatically, without any human intervention. At this point of development, AI will be able to have the control of its own existence, meaning that AI will be beyond the bounds of possibility to forecast what will happen (Maini & Sabri, 2017, p. 12).

Besides, giving AI the possibility to make decisions will heavily influence organizational structures and processes. The decision-making processes were before only reserved to managers, who were supposed to be the most aware of the needs of the organizations (Carillo, 2018). Organizations have already started to recruit massively “data scientists”, as they can “understand” data and make them “speak”. However, the key role of the manager in running organizations and taking decisions is then forgotten (Carillo, 2018). By letting AI taking decisions by itself, decisions might be too rational and might lack adaptability and disruption features, sometimes needed in certain circumstances (Chamorro-Premuzic et al., 2018). AI is not yet able to exercise humility, adaptability, vision and engagement, which are necessary qualities for leaders and decision-makers in organizations (Chamorro-Premuzic et al., 2018). Additionally, in the AI canvas presented by Agrawal et al. (2018), they clearly state that a human intervention is necessary to judge whether AI suggestions are correct or not. They recognize that AI is better than human for predicting and forecasting, but when it comes to validate a certain action to solve a situation, they assess that a human judgement is mandatory for the AI to better learn.

Furthermore, in the decision-making processes, we have recently showed that agents have to deal with multiple influences and motives when it comes to taking the final decision (Pomerol, 1997, p. 4). In this way, humans will prioritize these different aspirations in a very personal way, with their very own subjectivity. Consequently, this lack of judgement to balance and prioritize aspirations and motives can be a real obstacle in a fully autonomous decision-making with an AI agent (Pomerol, 1997, p. 22).

Finally, AI decision-making is limited by its programmed nature (Agrawal et al., 2018). If the code does not plan any decision-making responsibility for the AI agent, there is no chance for it to have the possibility to make decisions. Same if the programmer has wrongly designed the AI code, the AI will not be able to make good and relevant decisions and will appear quickly useless. A certain creative effort is needed form the programmer to design an impeccable code (Hurlburt, 2017, p. 9). Pomerol (1997, p. 3) is even harder in his words, saying that the very notion of decision is not compatible with the concept of a program, like AI, as the decision will not be fully made by the AI agent, but will be strongly influenced by the programmer. This consideration has to be slightly tempered as developments on AI have covered a lot since Pomerol (1997, p. 3) wrote his paper in 1997, and the autonomy level of AI has really increased over this time, especially regarding reinforcement learning AI (Maini & Sabri, 2017, p. 9).

Allowing AI to take part of decision-making processes in organizations, which are usually fully handled by humans, includes some clear advantages but also some limits. For
now, AI is not more than a machine empowered by humans, which implies some inevitable differences about human characteristics in its mode of operation, as emotions, trust, hermeneutics, intuition and experience. But what will it be under crisis situations?
3. **Research Methodology**

In the following chapter, the choice of methodology will be argued and the way how the research was performed will be stated. We will prove that we followed the research characteristics, namely a systematic data collection, a systematic interpretation of data as well as following a clear purpose of research (Saunders et al., 2009, p. 5). Regarding the limited space, we want exclusively to focus on the actual choice of methodology rather than explaining all different options of methodology on purpose. To guide our efforts, we first start by defining our research question followed by the research philosophy. Further on, we will present our research approach before reasoning the chosen research design. In the next step we will explain our choice and implementation of data collection, which is describing our interview guide as well as our method of sampling. The methodology part will be concluded by a description of our general analytical procedure and ethical considerations.

As already mentioned in our introduction, our purpose of research is to enlighten the question of how AI can affect crisis management. To avoid too many objectives for one study, we started to place boundaries, as suggested by Baxter & Jack (2008, p. 546). As it can be seen in figure 4, to remain within a reasonable scope, and moreover, to clarify the revealing convergence found in literature, as some predict AI helpful for complex decisions while others see potential in the application on uncertain decisions, we are exclusively focusing on decision-making processes as an important part of crisis management on the one hand, and one of the fields where AI is applicable for.

![Figure 4: The frame of the research interest](image)

By focusing on the influence of AI on decision-making processes under crisis situations, our study aims to clarify the opposing streams in literature about AI on decision-making, which mostly underline the unclear importance of the roles of rational and intuitive decision-making. To contribute on that point, the thesis at hand will especially explore the effect of AI on decision-making processes in the uncertain environment of organizational crises, which is so far barely researched. Thus, it will enlighten one part of the revealing convergence.
The vast majority of the sources and literature we used to elaborate our thesis were selected on Google Scholar and accessed through Umeå University library. We thereby prioritized articles according to their prominence, meaning how often they were already cited, and their actuality. Considering the crisis management literature, we were focusing on the pioneers of this topic. However, especially in the search of articles about AI, it was important to rely also on recent articles as the technological development is evolving fast. Unfortunately, not that many peer reviewed actual articles about AI on decision-making could be identified. Thus, we followed the recommendation of an AI expert, who offered us e-books and useful webpages.

3.1. RESEARCH PHILOSOPHY

Beyond the way how we chose and reviewed the literature, it is also important to understand the choice how knowledge got developed. According to Saunders et al. (2009, p. 108), the research philosophy contains important beliefs about one’s worldview, which will consequently impact the research strategy and method of our thesis project. Thus, the ontological and epistemology assumption will be presented in the following.

3.1.1. ONTOLOGICAL ASSUMPTION

Ontology refers to the beliefs about reality and about the view how researchers assume the way the world operates (Collis & Hussey, 2014, p. 47; Saunders et al., 2009, p. 110). It emphasizes the impact that one’s perception of truth influences what one thinks and thus, in turn, also impacts the research itself. Two main positions are considered to address the ontological perspective: the objectivist and the constructionist positions (Bryman & Bell, 2011, p. 20), sometimes also referred as objectivism and subjectivism (Saunders et al., 2009, p. 110), or realism and relativism (Killam, 2013). On the one hand, the objectivist perspective considers that social reality is totally independent from social individuals. To put it differently, an objective ontology assumes that only one reality and truth exists, without any changes (Collis & Hussey, 2014, p. 47). Contrary, constructivism considers that social events and their meanings are constantly being affected by social actors (Bryman & Bell, 2011, p. 22) and thus, multiple realities exist which are shaped by the context. It also means that reality and truth evolve and changes, and thus findings cannot be generalized but rather transferred to similar contexts (Killam, 2013).

This paper at hand follows a constructivist ontology. When considering the influence of decision-makers on crises, perception becomes important. Collis & Hussey (2014, p. 47) mentioned that the social reality is subjective and socially constructed. The different social actors interviewed have undoubtedly different points of view about crisis situations according to their backgrounds, experiences and values. In this case, there are multiple realities existing (Collis & Hussey, 2014, p. 47). This point has been enlightened earlier about the different perceptions that stakeholders can have from a similar event. When it is coming to crises, if a crisis in a certain organization is considered, top managers, employees, shareholders or external actors of this organization will probably not have the same perception of the event, and they will probably have completely different manners to speak about it, with their own subjectivity. Having a constructivist approach allows to better understand the perspectives of each of the interviewees by taking into account their individual context. Besides, as mentioned earlier, crises are unique events by nature, which makes the perception of the people involved in the crisis, highly unique and then highly subjective: the persons concerned by the crisis will then be the only ones in capacity to speak about the crisis. Finally, concerning AI technology, since AI is a field in current quick development, there is a chance that people interviewed from that field are
very enthusiastic and excited about the potential of this technology. Thus, it might be possible that their opinion concerning AI technology is biased.

### 3.1.2. Epistemological assumption

Epistemology is concerning what can be considered as an acceptable and valid knowledge in a certain area of study (Bryman & Bell, 2011, p. 15). It emphasizes the relationship a researcher has with his/her research. In brief, epistemology is about how to gather appropriate knowledge. It is important to realize, that ontological beliefs always dictate epistemological beliefs, meaning that what the researcher believes about the nature of reality will also dictate how the researcher should discover things (Killam, 2013). Thereby, two main paradigms exist: positivism and interpretivism (Collis & Hussey, 2014, p. 46). Positivism is thereby dictated by the objective ontology approach, whereas the constructionist position leads to interpretivism. To start with the former approach, positivism considers objective, tangible, observable and measurable phenomena as valid knowledge (Collis & Hussey, 2014, p. 47). To do so, the data collection has to be selected from an outside perspective, without interfering with the experiment. This is mostly related to collect data through observations (Killam, 2013). Contrary, interpretivism is about collecting data from “inside”, meaning that the knowledge has to be gathered from interaction between researcher and the data sources (Collis & Hussey, 2014, p. 47). This approach is often used in qualitative studies (Killam, 2013).

As mentioned earlier, the topic of how AI can affect decision-making processes in crisis management is dependent on perception and experiences of crisis. Thus, the extractible knowledge is created by meanings and experiences. Also, this paper follows a relativist ontology, dictating an interpretivist epistemology for our study. This makes sense, as there is more than one reality for our study existing and thus, collection of data cannot be done objectively. Thus, we embrace the interpretivist paradigm as our epistemological position. By interacting with participants of our study, the thesis necessarily deals with subjectivism to discover meanings and to understand the context (Collis & Hussey, 2014, p. 45). Since the aim of this thesis is not to give statistical figures about a certain object of study, but to clearly collect insights and deep thoughts to better understand the potential use of AI on decision-making processes in crisis management, the interaction between the participants and the researchers is unavoidable. Thus, knowledge will be created by the interaction between the researchers and the participants. This approach will allow to find out what valid knowledge exists in the study environment.

### 3.2. Research approach

When conducting a research in general, two main approaches can be considered: the inductive and the deductive approaches (Collis & Hussey, 2014, p. 3). When a research is following an inductive approach, it consists in developing theories from analyzing empirical data (Collis & Hussey, 2014, p. 7). In brief, it is about building theory (Saunders et al., 2009, p. 125). Contrary, the deductive approach is the reverse process, involving the test of a theoretical general idea based on an appropriate research strategy (Collis & Hussey, 2014, p. 7). In fact, it is about testing theory (Saunders et al., 2009, p. 124).

Considering our thesis project, the research follows an inductive approach, starting with the research question “How AI can affect decision-making processes under crisis situations?” and empirical data collection with the goal to develop a theory as a result of the data analysis. The purpose is to explore the nature of the topic as AI on decision-making in crisis situations is a barely researched field. The aim of the analysis following an inductive research approach will be the creation of a basis for a theory (Saunders et al.,
2009, p. 126). That may be that AI should be used in stable environments, as there is a relation between the application of AI and better rational decision-making. Or else, that AI is particularly helpful in uncertain environments, such as crises. Developing such a general understanding of a so far rarely explored topic is of course from benefit and achievable through an inductive approach.

3.3. RESEARCH DESIGN

In order to turn the research question and the research approach into a research project, an appropriate research design is necessary (Saunders et al., 2009, p. 136). This means, that a general plan of how to answer the research question needs to be developed. It is important to realize that there are many different alternatives existing, and depending on the particular choice, the research question will be answered differently. Based on our research objectives, we opted for an explorative, embedded, multiple case study, based on interviews, following a qualitative research approach.

According to Baxter and Jack (2008, p. 544), a qualitative research methodology should be used to study especially complex phenomena. With the potential to distill the complexity into more manageable parts and to explain complex context, this choice of research approach helps to deal with such complex research areas. According to Yin (2003) a qualitative case study design should be used for research questions answering “how” or “why”. This obviously fits our thesis goal perfectly as we aim to answer the research questions of “How Artificial Intelligence can affect decision-making processes under crisis situations?”. As discussed in the literature review, crisis management is a complex field of organizational studies as crises are always unique (Gundel, 2005, p. 114). Thus, it would be impossible to understand decision-making processes without considering the context within it occurred. All in all, a qualitative method will help us to gain insight into a variety of environments where decisions had to be made, exclusively under crisis situations.

According to Baxter & Jack (2008, p. 547), it is important to figure out what type of qualitative study will be conducted. As mentioned earlier, our research brings together two, up to now, barely related fields of research and expertise. Consequently, there is no clear evaluation or outcomes existing. Thus, our aim is to find out new insights and create new linkages. Saunders et al. (2009, p. 140) compares this kind of research with the activities of travelers, exploring new areas of the world. As a matter of fact, this type of study is called exploratory (Baxter & Jack, 2008, p. 547; Saunders et al., 2009, p. 139). It was interesting to realize what Saunders et al. (2009) wrote in their book about this choice of methodology. They state, that the “willing to change direction as a result of new data that appears” (Saunders et al., 2009, p. 140), is necessary within exploratory projects. Moreover, the initially broad focus progressively narrows down as the research progresses. This is exactly what we experienced during our first weeks of our thesis project and what challenged us most.

Taking into consideration the context of our work, for an exploratory study, three main ways of gathering valid and reliable data are common: searching in literature, interviewing experts or conducting group interviews (Saunders et al., 2009, p. 140). As we combine two so far separate fields of research, whereas one of them is developing rapidly, the circumstances make it impossible to bring new elements only by analyzing existing data and literature. Moreover, both of the fields of research are very specific, since AI is super complex technologically speaking, and crises are unique by nature. Thus, having a real knowledge about these two fields, which can bring a real contribution to this paper, is not reachable for non-expert persons. Then, there was the necessity to get in touch with both
experts from organizational - i.e. crisis management - but also engineering - i.e. AI - environments. With semi-structured interviews, this duality can be solved, and our complex topic of interest can be well explored. Semi-structured interviews are unstandardized interviews which are “often referred to as qualitative research interviews” (Saunders et al., 2009, p. 320). Thereby, a list of themes and questions are prepared, although they may differ from interview to interview (Saunders et al., 2009, p. 320). The interviews were conducted one-to-one, and because of the internationality of our contacts, we decided for Skype and phone interviews.

With the goal to be consistent in the nature of our interviews and our research question, meaning to get a first broad overview of how AI can affect decision-making processes in crisis management, we decided for a multiple case study. Also, Baxter & Jack (2008, p. 556) mention, that using a variety of sources can illuminate a case. In our work, we focus on cases dealing with crisis. Embedded multiple case study, meaning focusing on more than one particular company and case (Saunders et al., 2009, p. 147), will ensure that the issue is not explored through one single lens, but rather a variety of perspectives will help to understand the complex and unique area of crisis management on the one hand, but more precisely the effect of artificial intelligence on decision-making in crisis situations. By this, different objectives and cases will result in a broader picture, will show similarities and differences between decision-making processes within unique cases as crisis are and possibilities and threats of AI. Lastly, multiple case studies are considered to be robust and reliable (Baxter & Jack, 2008, p. 550).

Of course, every choice research method has its downsides and we are aware of them. Conducting qualitative analysis through multiple embedded case studies can generate overwhelming information. To explain, by focusing on many cases, a lot of data and examples can be gained, and one can easily get lost in data as it is important to filter the really important information. To not get lost with the massive amount of data and to not focus on futile and inutile elements, we used the general analytical procedure further explained to carefully select the most important and relevant elements. Contrary, multiple case studies can also lead in a lack of data, as researchers do not gain deep insight in each single case, making it difficult to understand the case as a whole and thus, there might relevant information missing or overseen. Moreover, in qualitative analysis there might subjectivity be included. To avoid a lack of exploitable data and subjectivity, we asked as much as possible follow-up questions, reformulations and examples to our interviewees, to always get the most transparent and fed information possible.

However, regarding the combination of two fields of research in an explorative way, where the linkage must first be created, the advantages of qualitative research based on semi-structured interviews of multiple embedded cases seem to outperform the issues of our choice of methodology.

3.4. METHOD

Based on the explanation of our choice of methodology, we now want to continue explaining our data gather technique or, in brief, our choice of method in detail. As mentioned above, our thesis project is based on data collection through interviews. Before starting to explain the interview guide, we want to point out, that we started to interview one crisis management expert and one AI developer before creating our interview guide. As suggested by Saunders et al. (2009, p. 153), this helped us to be more confident about the topics and to figure out the most important issues.
Moreover, we summarized our entire literature review in order to get a broad bird’s perspective of our topic after being buried in the depths of our field of research. What we already know, and which gaps exactly need to be filled came perfectly clear by this. Moreover, it was important to order the topic areas well, so that the questions’ flow appeared logical and fluid to the respondents (Bryman & Bell, 2007, p. 475).

Based on our literature review, we started to create two separate semi-structured interview guides, which will both be find in the appendices 2 & 3. The first one was for the interviews with crisis management experts, the other one for AI developers. Both questionnaires started by pointing out our goals of the study, namely to find out what is really important in decision-making processes in crisis management, to figure out which experiences and fears crisis managers have with new technologies such as AI and lastly, to explore how AI’s technology can replace important features of decision-making processes in a foreseeable period of time. By doing so, we made sure that both parties, interviewer and interviewee, were aware of the study’s goal. The semi-structure of our interview guide allowed us to understand the participant’s opinion (Saunders et al., 2009, p. 334), but also to come up with new questions and ideas related to the interview progress.

Hereinafter, we spent a paragraph to introduce ourselves and our background of study briefly and inform the interviewees about their rights and to check confidentially requirements. Moreover, this part helped to warm up with our interviewees.

The next paragraph is called “General information about the interviewee”. Bryman & Bell (2007, p. 475) call this section of the interview guide “facesheet”, meaning to gather information of general kind (e.g. name and age) and specific kind (position in the company, number of years employed, etc.) about our interview partner. This information could be particularly important when it comes to contextualizing and maybe also prioritizing the answers.

In the third part of our interview, we decided to give a brief overview about the topic the interviewee was unfamiliar with. To exemplify, when interviewing AI experts, we quickly wanted to summarize the main facts about crisis management, whereas when speaking to crisis experts, we wanted to introduce the basic idea of AI in a short, easy and comprehensive way. Similarly, we introduced shorty crisis management to crisis experts.

In the subsequent section of our interview, the two interview guides really started to differentiate from each other. However, in both parts we were aware of formulating our questions in a way that will help to answer our research question without being too closed and specific. Moreover, we formulated the questions in a comprehensive way, fitting the background our interviewees (Bryman & Bell, 2007, p. 475).

Considering the questions for crisis experts, we divided the questions into two subfields: first, we started with general questions about decision-making processes in crisis management. In this part, we wanted to figure out the importance of decision-making in crisis situations and how it differs from daily decision-making in an organizational context. Moreover, we wanted to explore how experts value rationality, intuition and the identified influence factors within the decision-making process. Lastly, we focused on decision-making skills within different crisis stages and crisis typologies in order to see if there are any differences existing which might be relevant when it comes to the application of AI. Second, we focused on AI on decision-making processes in crisis management. In this subfield of our interview guide, we wanted to get aware of how crisis managers assess the possibilities of AI on decision-making processes in crisis management. To know
about gained experiences, threats but also opportunities one sees definitely helped to figure out how AI should be developed further in order to meet the requirements.

The questions for the AI developers were also classified. We started with questions of AI on decision-making processes and went deeper into the topic with AI on decision-making processes in the area of crisis situations. In the first part, we wanted to explore to what extent AI is already used for decision-making processes in general. Moreover, we wanted to check what developers think about AI’s ability to cover rational and intuitive decision-making skills. The three main fields of machine learning (supervised learning, unsupervised learning and reinforcement learning) has been discussed in more details within this part as well. It contributed to our limited understanding of informatics as business students. In the latter part, namely AI on decision-making processes in crisis situations, we covered questions concerning the future development of AI. In particular, we wanted to find out to what extend AI experts dare in the technology when it comes to uncertain environments, which benefits and limitations they see.

Finally, we concluded both interviews with the closing question in what our interviewees see the major competitive advantage of AI compared to humans and contrariwise.

3.5. PILOT TEST

The pilot test, or the pre-test, is mainly used in research when conducting interviews (Bryman & Bell, 2011, p. 262). Pre-testing questions allow the researchers to design (and redesign) the interview guide to make sure that the final respondents will not have any problem answering the questions (Saunders et al., 2009, p.394). Using a pilot study can allow to detect questions that are too simple, too technical, not understandable or even to figure out questions that make interviewees feeling uncomfortable (Bryman & Bell, 2011, pp. 262-263).

As the interviewees of our interdisciplinary study are experts in their field but do not have advanced knowledge about the other field of our research, a pilot test was particularly important to ensure that our respondents will have no problem to understand the few questions which are overlapping the business and engineering area. Out of that reason, the interview guide was tested with people who are neither expert in crisis management, nor expert in Artificial Intelligence but who share an academic level of knowledge (i.e. students).

3.6. SAMPLING METHOD

As it is impossible for researchers to gather data from a whole population, a sampling method is required (Collis & Hussey, 2014, p. 131). Moreover, due to time constraints, the selection of a small but qualitative target population was indispensable (Saunders et al., 2009, p. 212). By using these techniques, it is possible to shrink the quantity of data collection massively. Thus, it ensures collecting information from representatives of an entire population, and therefore, the results can be generalized to the entire population anyway (Saunders et al., 2009, p. 210).

Thereby, two main types of sampling exist: non-probability sampling, also called judgmental sampling, and representative sampling, or probability sampling (Saunders et al., 2009, p. 213). A probability sample is based on the principle of randomly picking individuals in a certain population to constitute the sample. In other words, anyone in this certain population has the same chance to be picked to be part of the sample (Bryman & Bell, 2011, p. 176). This method allows to generalize the findings, and the results are
supposed to represent the target population appropriately. On the other hand, a non-probability sample is the opposite, meaning that it is not based random selection, rather, according to some particular characteristics, a specific part of the population has more chances to be selected into the sample than other parts of the population (Bryman & Bell, 2011, p. 176).

The present thesis is based on a non-probability sampling method as the expertise of two specific and so far, rarely overlapping areas, crisis managers and AI, is required. As Saunders et al. (2009, p. 237) state, this choice of sampling is particularly efficient for small samples. Moreover, due to our student status, we had limited access for resources, which limited the community choice (Saunders et al., 2009, p. 233). However, to collect appropriate and relevant data to answer our research question, the pertinence of the expertise of our interviewees on the areas of interest must be ensured. Thus, a purposive sampling, which is the selection of respondents according to the depth of their expertise on the subject under study (Collis & Hussey, 2014, p. 132), was chosen. Based on the gained contacts, we combined the purposive sampling method with the networking, or snowball sampling. By using this method, more interesting representatives of the population of interest could be identified and interviewed (Collis & Hussey, 2014, p. 132).

Finally, thanks to our personal network and to the network of our first interviewees, we were able to interview 5 respondents for our study. In addition to interviewees, we also went to a conference held by an AI expert, from which we were able to take notes of relevant elements for our research. As described earlier, the sample was divided into two parts: crisis experts on one hand, and AI experts on the other hand. When we built our sample, we took into consideration that we are conducting an exploratory study and we wanted to have a broad view of our topic, without focusing on one type of crisis or one type of AI. Therefore, as appropriate data for our research, we contacted 3 crisis experts: one expert of nuclear risks and crises (interviewee 1), one crisis management consultant (interviewee 2), and one global human resource director of a listed French company (interviewee 3), who is used to deal with corporate crises. The exploratory specificity of our research has made us choose to not have our crisis experts’ interviewees from the same organization, or from the same industry, which is the case for a lot of business researches, but we had the desire to interview persons who have really worked on crisis management or who had experiences of dealing with crises. Secondly, we interviewed 2 AI experts: one AI expert working in a non-profit which promotes an ethical and respectful development of AI (interviewee 4), and one AI expert working in a nonprofit specialized in applied research in information technology and technology transfer (interviewee 5). In the same way than for crisis managers, our AI interviewees were not from the same organization or they did not have the same specific job: we chose to interview people who had a real knowledge about AI, since the technological progress of this field is moving quite fast. Thus, their belonging to a specific organization was not a matter of importance, as long as they could provide us relevant insights and thoughts about our questions. As said earlier, we also took notes from the conference about AI, since the main speaker was an expert on both AI and business matters (interviewee 6), and he gave some tangible and accurate explanations and examples that we used in this paper. Finally, the length of the interviews was comprised between 44’26 and 88’28 long (appendix 4). We gave an estimated time for the interview of a little bit less than one hour, but we let the interviewees answer freely to the questions, by letting them speak if they were inspired.

3.7. GENERAL ANALYTICAL PROCEDURE

After collecting data, the gained information needed to be analyzed. To ensure a systematic way of analysis, we made use of a general analytical procedure. The procedure has
been developed by Miles and Huberman (1994, cited in Saunders et al., 2009, p. 503) and consists of three main steps: data reduction, data display, drawing and verifying conclusions. The method is commonly used to analyze qualitative data (Collis & Hussey, 2014, p. 157) thanks to its systematic approach to inspect and scrutinize data. To fully take advantage of this method, interviews were recorded and transcripted in regard to have a direct and easy access to the data.

The first step of this procedure, data reduction, consists in resuming, and shorten the gathered data to finally focus only on the important parts of the data (Saunders et al., 2009, p. 503). After having transcribed the 5 interviews and the conference notes, we identified the most interesting and relevant quotes and elements of both types of body experts in a first instance, to then attribute a ‘label’ for each interesting element, summarizing the main idea of the element. For our study, we reduced the data only to the elements that were important for answering the research question. Thus, the labels were the following: ‘nature decision-making’, ‘teamwork’, ‘training’, ‘role of intuition’, ‘AI for decision-making’ and ‘AI for decision-making in crisis management’.

The second step of the process is called the data display and is used by the researchers to visually compile and outline the most pertinent and relevant data (Collis & Hussey, 2014, p. 159) by aggregating them into common topics or subjects, in order to make links between the answers of the different respondents. For this step, we used the labels that we attributed earlier to each quote to build small groups of quotes on the same topic. This method helped us to get a clear and precise idea about our findings and how to structure them.

The last step is drawing conclusions and verifying them (Saunders et al., 2009, p. 505). This final phase allows the researchers to present clearly their findings, and to discuss them later on. For this last step, we presented our findings according to the headings in a logical structure, to make the reading easier. Thanks to the literature review we conducted earlier, we were able to have a certain understanding of each main theme addressed by our interviewees. This helped us to better present and discuss the findings and draw the conclusions.

To display the findings, we preferred to gather the findings from both, crisis experts and AI experts, even we were conducting separate interviews with distinct interview guides. Thus, we decided to compile findings altogether from both sides already in the results part because our topic is about the overlapping of the two fields. Moreover, it also helped to have a clearer and unique picture of each theme addressed with the interviewees, instead of repeating themes twice. It also helped to better notice both points of agreement and disagreement from both experts and to better catch the challenges and the points of interest. Finally, thanks to the findings gathered and linked to the elements from the literature review, it was possible to highlight opposing, converging and new elements. We first started to highlight two main factors of decision-making in crisis management, which are comprehensiveness and speed, with a special focus on the influence of rationality, heuristics and intuition. Thus, a model of successful decision-making in crisis management has been developed, with the two factors already mentioned, comprehensiveness and speed, combined with short- and long-term effects. Then, the role of AI and human agents in this model was exemplified, to finally answer the research question.

3.8. ETHICAL CONSIDERATIONS

During the thesis project, we took some research ethics concerns into consideration. These research ethics mainly relate to the way we were conducting our research and the
manner we presented and use the results and the findings (Collis & Hussey, 2014, p. 30). Research ethics are concerning the whole research: at each step of the study, from the research question to the findings, researchers should consider them in their way to conduct their study. It is then possible to define research ethics as all the questions that may arise considering the way researchers will design and explain the research question, their approach used to conduct the research, their way data are collected, stocked and analyzed, and their way to express the findings (Saunders et al., 2009, p. 184). Taking these potential ethical issues into consideration while we were conducting our study was important for us, to be able to produce a work of both high quality and respectful to these considerations.

Various ethical principles can be considered when conducting a crisis, but we decided to focus on the four main ethical assumptions emphasized by Bryman & Bell (2011, p. 128): “whether there is harm to participants, whether there is a lack of informed consent, whether there is an invasion of privacy, and whether deception is involved”. Indeed, it appeared important for us to make sure that our respondents would not be physically or psychologically harmed (Collis & Hussey, 2014, p. 31) by the way we were conducting our research. To prevent this threat, we designed semi-structured interviews, which allowed us to be adaptable during the interviews. We also let our interviewees know that they could withdraw from the interview at any moment, and with no implications for them. Besides, dignity has been also highlighted (Collis & Hussey, 2014, p. 34) in research ethics, since respondents should be considered with respect, and they should not feel humiliated or annoyed. To respect this assumption, we endeavored to be as polite and cordial as we could, by never questioning their claims directly in case of misunderstanding but asking further questions to better comprehend their point.

Then, it came out essential to obtain a full and total informed consent from our participants in our research (Collis & Hussey, 2014, p. 31), as a lack of informed consent can be harmful for a business research. A respectful approach for the participants is to provide them enough information upstream to the interview, to let them the possibility to make their own decision about their participation to the study (Bryman & Bell, 2011, p. 133). That is why we first contacted our potential interviewees individually with a short presentation of our study and to make them know that we were asking for their participation to our research. After their first acceptation to be part of our research, we introduced to all our interviewees a short presentation of our topic, our purpose, and how we designed our study. We also asked them to record the interviews in order for us to proceed an easiest and more pertinent analysis of the data. Then, we made sure to get the real agreement in participating the study and in collecting their data.

Third, we were convinced that it was important to protect the privacy of our respondents. Trying to reach the objectives of a study does not allow researchers to break into interviewees’ privacy (Bryman & Bell, 2011, p. 136). Thus, we mentioned to our respondents that they will stay anonymous for the whole process of our study, and that we will keep their information confidential. Offering participants anonymity and confidentiality implies that there is no possibility for the respondents to be identified through their answers (Collis & Hussey, 2014, p. 32). In this manner, we coded the name of our interviewees in our data collection and data analysis. By doing this, we increased the chance for us to have trustworthy and credible answers from our respondents.

Finally, managing the potential deception of our interviewees was significantly important for us. Deception is perceived by respondents when the researchers are presenting their study in a certain manner, which is far from what it really is (Bryman & Bell, 2011, p. 136).
We endeavored to always tell the truth to our respondents and by never manipulating them or their answers. Recording interviews was a manner for us to ensure authenticity of our interviewees’ answers when presenting and discussing them. We also offered to our respondents to send them our thesis when we will have finished our thesis, that they will be able to read it and confirm that we respected what we presented to them.
4. RESULTS

The following section will present the main findings gained through data collection and finally discuss them in the context of the underlying research question of “how artificial intelligence can affect decision-making processes in crisis management”. First the findings obtained by interviews with both crisis and AI experts will be presented. The final discussion of the results will then be based on either opposing, equivalent or completely uncovered beliefs and opinions and will compare empirical findings with the findings concluded after reviewing the literature.

4.1. FINDINGS OF DATA COLLECTION

4.1.1. THE NATURE OF DECISION-MAKING IN CRISIS SITUATIONS

While considering crises, one shared perspective is to solve the situation with the least damages possible for the organization and for the stakeholders. In this sense, crisis managers are asked to make “good decisions” to stem the crisis. According to interviewee 2, “it is very complex to make decisions in this kind of context” as crises are a mix of “uncertainty and risk taking in complex systems”. Therefore, good decisions under crises possess specific and unique features that good decisions in the normal run of operations do not have. First, it appeared that timing, when taking decisions in crisis management, is a key component for success or failure. Good decision-makers are ones who are able to make “good decisions at 80% but at the right time” rather than having “the answer at a question that arrives too late, which would be maybe better because closer to the 90%, but too late, so it becomes a bad decision” (interviewee 3). The same respondent continued, “in every case, and especially in crisis situations, decision is better, even imperfect, than no decision at all”.

Besides, managers who wants to make good decisions in uncertain events have to ensure the feasibility of their decision. Meaning, that they need to keep a certain control on their decisions and on the consequences of their decisions, as interviewee 2 said, “the idea is to not make the good decision, it’s to make the decision which allows to have a real action power.” Losing control of the situation is a real risk for crisis managers. Out of that reason, “lucidity and calm are (...) key competencies for managers in crisis situations” (interviewee 3). Additionally, taking good decisions is highly contextual. In a pyramidal system, the risk is that the upper layers of the structure will take the lead to decide in case of a crisis (interviewee 3). However, it appears that in most cases and in favor of the decision’s feasibility, “the best person to make the decision is the one [closest local manager] living the situation”, “he is the one having the right information to make the decision” (interviewee 3).

Beyond possessing the correct information at the right time, taking good decisions seems to be influenced not only by the quantity of information the manager will obtain, but also by the quality of these information. Interviewee 2 disclosed that “there are plenty of cases where decisions have been made without a lot of information, like in battles or wars. Decisions are not always related to a quantity of information, but more to quality of information”. Thus, he even thinks that a single sure and reliable information can be enough for the decision-maker to make his decision (interviewee 2).

Finally, when being in command to solve a crisis, the manager should succeed to consider both short-term and long-term perspectives (interviewee 1). Decision-makers have to be
very careful in their judgement and in their arbitrages: some solutions that can appear

great for the short-term can potentially be dangerous and critical in the medium and long-
term (interviewee 1), and managers should absolutely stay away from these options. In
that respect, “it is important while dealing with crises to have a long-term vision: I had
to first solve the short-term issues, to avoid any deterioration of the situation, but if I have
to include a long-term vision fairly soon as well” (interviewee 1).

As shown above, taking good decisions under crisis situations is multifaceted, while tak-
ing into consideration timing, feasibility, quality of information and a long-term vision. To
achieve this, a teamwork approach for decision-making is considered by organiza-
tions.

4.1.2. TEAMWORK APPROACH FOR DECISION-MAKING

Crisis situations can be considered as particularly complex, intricate and stressful situa-
tions. Thus, organizations are “less and less ready to rely on only one person” (inter-
viewee 3) when it comes to making decision. A group work approach, mentioned by
interviewee 2, is commonly adopted to manage crises. Thereby, it should be “two teams
involved in crisis management: one is directly acting to solve the crisis on the field, taking
operational decisions, and the other one is usually a bit far from the situation, a step
backward” (interviewee 1). However, crisis managers should always “be connected to
operational concerns” (interviewee 1) to ensure the required communication flow. By
implementing such teamwork approach, organizations “avoid as much as possible to have
the same person making the decision and applying it” (interviewee 3) since trying to play
all the roles in this kind of event will hinder the decision-maker to “anticipate the next
step of the crisis” and to be in “a peaceful mode to analyse the next elements and to take
into consideration previous decisions in his next decisions”. Having this separated system
of crisis teams also allows “to have an independent voice from the production and sales
processes, not only to avoid conflict of interest, but also to make good and relevant deci-
sions” (interviewee 1). More generally, having an independent and free voice from the
field of the crisis is apparently needed to be able to consider the whole picture of the
situation and to make the appropriate decision.

4.1.3. THE IMPORTANCE OF TRAINING

In order to get a whole picture of the situation and to make an appropriate decision, train-
ing is necessary (interviewee 2). Organizations seem to put a special focus on training the
main managers for crisis situations (interviewee 3). According to interviewee 3, “80% to
90% of regular situations can be dealt by normal exercise of management” but “10% of
exceptional situations (...) might be highly disturbing for organizations. And managers
are usually not well prepared for these 10%, as they are exceptional and occurring in
really short periods of time”.

Training leaders for crisis management is not only giving them tools to pilot an organi-
zation in these difficult events, it is also teaching them how to prevent crises. Interviewee
2 explained that different types of crisis exist: there are “brutal crises, that are occurring
immediately” and for which organizations are “directly facing a wall” and there are “cri-
ses that are coming progressively”, for which there are “weak signals appearing” and
eventually organizations “shift into a crisis mode”. Being able to apprehend, identify and
measure these early warning-signs can give a real advantage to an organization to face a

 crisis. However, even if managers are “monitoring a list of weak signals”, “crises are
from the domain of the unknown. In the case of the 9/11, CIA knew that there were some
As mentioned above, crisis management is not only teaching tools, not only being better aware of crises and thus, being able to better apprehend weak signals, it is also about making manager to react quickly and to create reflex actions (interviewee 1). As interviewee 3 stated, “the best way to make decisions is to develop reflexes, which are related to routines learned in exercises”. In addition to exercises, these reflexes can also be the “implementation of good actions and good practices learned from past crises” (interviewee 3). To exemplify, when considering the pilot who landed his plane on the Hudson in the US several years ago, “during 20 years of experience, at each take-off, he was looking somewhere to land in case of a problem, and he developed a reflex, and his reflex came super-fast at his mind when he lost his engines” (interviewee 3). “A lot of past experience came in his mind at the right time, to make decisions and act faster” (interviewee 3). Hence, routines seem necessary to deal with crises since it will help managers to better identify weak signals of an incoming crisis, but also to better handle crises through reflex actions, which are influenced by the managers’ intuition.

4.1.4. THE CONTROVERSIAL ROLE OF INTUITION

When it comes to intuition, a decision is influenced by several factors such as emotions, perception, heuristic and experiences and there is no clear opinion between experts, about whether it is beneficial or adverse. Interviewee 1 exemplified with the consideration of an airline pilot and a fisherman on his trawler, both facing a storm: “one will reduce and avoid the risk, and the other one will learn to manage it” (interviewee 1). The fisherman is doing “acrobatics every time he has to deal with a storm” (interviewee 1), so he is piloting his boat thanks to intuition, while the airlines pilot is “in an industrial process” and he has to follow “rigorous procedures”. In this kind of context, “there is no room for intuition”. Interviewee 1 concluded, intuition is “not meant for industrial matters: you need authorisations, certifications”. Interviewee 3 even added “the word ‘intuition’ in crisis situations scares me more than reassure me”. On the other hand, in most cases, having a full understanding of the situation is impossible, as these events are “too complicated for a human brain” (interviewee 1) and thus, intuition gets crucial.

Starting with the first belief, that intuition should be eliminated as much as possible: in organizations, especially in crisis situations, decision-makers have to make people follow them in the decisions made to reduce the crisis. It is hard to imagine that a CEO could just say to his followers “listen, I feel it like this” in a middle of a crisis, as expert 3 illustrated. Intuition can help in some other situations, but if a low risk level is aimed, as it is the case in crises, organizations have to cope with “serious things, never funny, like procedures and you need to have a rigorous approach” (interviewee 1). According to interviewee 3, the main issue with intuition of managers is that “if at one moment the one at the head of the group is having too much intuition on too many things, the group will lose its coherence and people won’t follow the decision maker”.

Moreover, and as said earlier, crisis situations are bringing a lot of uncertainty by nature, since they are hard to predict, and people cannot fully forecast their evolution. Thus, if leaders decide under their intuition, it will inevitably create more uncertainty to people who have to follow them. It comes clear by the statement of interviewee 3, “to not let space to uncertainty” (interviewee 3), the elimination of intuition will be beneficial for uncertain situations. The same expert gave a concrete example: “in a commando mission,
everyone knows his position, his role, everybody has trained together, and then, you minimize the uncertainty because a maximum of things has been anticipated and the group knows how each member will react, or how the group will react as a whole”.

Based on these assumptions, more and more companies are “developing preventive routines thanks to the collective or individual past experiences” (interviewee 3), to make sure that managers will make their decisions based on the beneficial part of experiences (i.e. routines and reflex actions), rather than based on intuition as a result of “biased [...] experiences” (interviewee 3) or emotional experiences. When considering the “emotional dimension of the crisis”, it might induce a “loss of lucidity”, as interviewee 3 stated. Interviewee 2 added, in some extreme cases, being “managed by emotions can lead to disasters” and can even exacerbate the crisis. Especially when “the decision maker is subject by something irrational and not controllable: stress” (interviewee 2), the findings showed, that dealing with stress and its underlying emotions are one of the biggest limits of human when solving crises.

However, a debate is increasing on the rising role of intuition in crisis, and on the emergence of “heroes” (interviewees 1 & 3) or “strategists” (interviewee 2). Interviewee 1 exemplified by the nuclear crisis in Fukushima: there are two nuclear power plants, ten kilometers far from each other, and during the crisis generated by the tsunami, “there was a different positioning of the two directors towards regulation and authorizations. Basically, one decided to not follow some things, and not the other one”. The reactor, where the decision-maker acted intuitive, against rules, did not explode, whereas the other reactor exploded and led to a huge nuclear catastrophe. This example shows that “when you are in a crisis, most of the time, you are in irrational. These are things you have never lived” (interviewee 2), and it is not always inimical.

All in all, the findings show that there are opposing beliefs about the role of intuition existing. On the one hand, intuitive decision-making processes can generate a lack of followership and can bring even more uncertainty to situations. On the other hand, intuition can also be beneficial, as some practical examples showed. It is a matter of fact, that in crisis situations, a leader will be “heavily influenced” (interviewee 2) in his way to take decisions by his “instinct, his experience and his intelligence towards stress”. Sometimes human just ‘react’ because they “feel it like this” (interviewee 3).

4.1.5. HUMAN DECISION-MAKING ABILITIES AND LIMITATIONS

This bipartite role of intuition is what human intelligence is all about: there are advantages and limitations existing. Interviewee 4 stated that “people overestimate their uniqueness of thinking”. Interviewee 5 pointed out, that humans have the advantage over AI agents to be able to influence others. Moreover, they are also aware of the human advantage of being able to “justify decisions” (interviewee 4). He even gave a useful example when saying: “if you take a board member that makes a decision, e.g. outsource a certain part of the company to another country, then you would probably expect as an employee that he can justify that decision”. Furthermore, interviewee 5 pointed out, that humans can always “add [new] input data” at any moment in order to better understand a given situation, which is not easily possible for AI as it is highly dependent on a big amount of initial training data, which will be clarified in more detail later on. Finally, interviewee 2 sees the strongest advantage of human intelligence compared to AI intelligence in the fact that humans “can still surprise”: “that is why strategists can succeed to make disruptive decisions with ten steps ahead, and we realize much later they were right”.

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But humans present also some limitations when it comes to managing crises successfully. Individuals will have their own perception of a given event which can lead into being “biased by his experiences” (interviewee 3, interviewee 4). Respondent 4 epitomized, “if you have an ex-boyfriend who has a special facial feature and you had an “ugly” break-up, then for the next few years, you might be biased whenever you see someone who has such a similar facial feature. [...] singular events are so strong in their impacts”. Such influential factors on human intelligence is “something about which there is still no good understanding, because [we] just do not know exactly how it works in humans”. Unfortunately, interviewee 4 continued, this can lead to “suboptimal decisions” made by humans. The same respondent illustrated: “Imagine [a dam] - it can break either the right half of the dam, where 10 people are living, or the left half, where 1000 people are living. But in the right half the manager’s family lives. In this case, the manager would probably make a sub-optimal decision. AI makes the decision much more objectively and rationally” and decides for the right half, even if the manager’s family will die consequently.

Lastly, in some crisis cases, like in the nuclear sector, humans will “really quickly realize that something is going wrong but having a clear and precise idea of what is going wrong, and why, is something else” (interviewee 1). This impossibility to identify quickly and accurately what is happening, what are the causes, and what could be the potential consequences is coming from the fact that “human beings are made in a way that, if there are more than ten elements, it starts to be hard for them to understand” (interviewee 2). Thus, in brief, it could be identified, that humans have a lack of analytical skills, especially in crisis circumstances. Being aware of these major limitations of individuals to properly manage crisis situations, and “with the massive amounts of elements there are in databases nowadays” (interviewee 2), it starts to be mainly accepted that “it is impossible to manage them anymore without AI”. By having a clever use of AI to deal with crises, “AI will maybe help to relieve decision-making” (interviewee 3) and managers may be able to make ‘good’ or at least better decisions. In brief, they are slowly when it comes to a comprehensive thinking process.

4.1.6. AI FOR DECISION-MAKING

Due to the limitations of human intelligence, the idea of developing a machine which is as intelligent “like humans or even more” (interviewee 4) appeared, already in the 70s as interviewee 5 declared. Interviewee 6 introduced AI’s state of the art as “artificial intelligence is a way of thinking [...] it can be understood as machines that start to understand their environment [...] and is about adding new technology to business”. In the light of decision-making processes, interviewee 4 was clear with his statement that it is not an application on decision-making, rather “decision-making is [...] the core of AI” - “You have a perception of the environment and then you make a decision and then you interact with the environment so that you can realize the decision”. This loop: perceive, decide, impact is exactly what decision-making is about. According to expert 4, “the question is basically, what types of decision you let AI do already today”.

Especially in simple and binary decisions (e.g. left or right, black or white), the development of AI is already very good today, as interviewee 5 let us know. Even if AI would probably be capable to solve more complex problems, the developers are still focusing on the application of AI on smaller problems. Interviewee 4 explained, “you could also refer to reinforcement learning to product development: e.g. should we develop a product, or do we leave the product range as it is. Thus, you can solve any problems with it. The problem, however, is that AI nowadays needs a lot of data to make good decisions. That's why you start with such simple problems. When balancing a bottle [on my finger], I know within 1 second if my decision to move in the way I moved was correct or not, because
either the bottle stays on my finger or the bottle falls down. With a complex example as in product development, the impact takes much longer. Say, if I decide today to take on a new product, it may take months or years before I know if the decision was profitable”. “How far AI is away from programming a robot that "walks around the world", interview 5 pointed out, comes clear when realizing that even “for a red-green-decision you have 16-24 layers” of programming.

However, the technology is capable of more, but it is limited to its applications to simple problems, as it is needed to better understand the technology first, as interviewee 4 figured out. Essentially, the idea of AI in the context of decision-making is, that AI “should be more efficient than human beings decision”, interviewee 4 clarified. Thus, the development of “AI is the try to leave bigger decisions to computers. Decisions with so many parameters that people can no longer perceive” (interviewee 4). The tactic of today’s AI developers is, interviewee 4 stated, to “[look] for the hardest problem [one] can just solve”.

Some examples of decisions, which are already made by an AI agent, and where too many parameters are involved to be easily manageable for the human being, were given by interviewee 4. For instance, “risk modeling for banks: who gets a loan? There, you have a huge model with many parameters about the loan’s applicant. A person would look at this and need a simple scheme such as "if the applicant belongs to a certain category then he will be rejected" (if ... then ...). But AI can recognize relationships that would be too complex for humans. For example, if an applicant originally comes from Italy and entered the US 20 years ago and applies for credit [in the US] and lives in a certain area of NY, then the risk that he is with the Mafia is greater than that of someone lives in XY. So, it’s just that AI can see a pattern that results in the decision to not get the credit. Such complex relationships are only workable for people if you look at everything explicitly. The AI technology can automatically find such correlations. For example, if it turns out that there is a pattern in which a loan went wrong by people sharing any attributes, then the loan is rejected by a claimant with similar characteristics. Recognize patterns from large amounts of data and optimize decision-making processes with respect to past patterns. That’s artificial intelligence these days - better than human abilities”. Based on the same idea, interviewee 4 came up with another example, which is even more decision-sensitive: “It’s about predicting whether criminals will be repeat offenders. And on the same principle as with the creditworthiness, AI will make a decision whether the offender is released on probation or not”. This example was also one of several which lead to deep discussion after the conference between interdisciplinary experts. Moreover, interviewee 5 clearly underlined, that AI already gets more power for important decisions with bigger consequences. He demonstrated by using an example out of the medial sector: “for example, it is just coming to the point that all the diseases, symptoms, etc. get collected and an AI can detect diseases based on these [input data] and the symptoms of “new” patients. [...] To illustrate, if an AI makes the decision "you have leukemia" - then of course that is very stressful finding for the person affected. If that is not true, of course, it would be stupid”. Lastly, both interviewees (4 and 5) made use of the development of autonomous driven cars, where the actual level of development reached 3 out of 5 (interviewee 5), and where the impacts can be even more important as humans trust their live into the driving skills of an AI agent.

The business application made by the company of interviewee 6 shows that AI can maximize the output of several decision input parameters. In this case, AI is used to find the optimum between the 3 parameters “user preferences”, “market trends” and “properties”. In order to predict user preferences, the machines make use of a similar recommendation
processes as Netflix does. The intelligent machine searches for users with similar attributes as the potential customer has. As a result of that, the algorithm recommends properties which are probably fitting the customer’s interests. As mentioned several times, also in this case, the input data is from necessity to get a valuable output from it. In this case, the company solves this problem by a cheap way of data gathering. Interviewee 6 explained, “make the user work for you!”. The company gains their information with a data collection as easy as the dating app Tinder is: potential customers get to see properties and they simply decide whether they like them or not. These preferences will later be the basis the recommendations for users with same/equal favors. The second variable, market trend, can consequently be predicted through the changes in preferences predicted through their data collection. The properties, and therefore the last of the three parameters, are the easiest part of this AI, as they are simply entered as input data.

As this business application shows, and as interviewee 6 underlined, AI “is an industrial evolution, it will be everywhere, it will get better and better over time”. Through all those examples, it could be figured out, that AI is still applied for narrowed problems with a clear goal, in order to fasten up the learning process. However, the applications get more and more complex, and AI is more and more applied for decision-sensitive areas.

4.1.7. AI FOR DECISION-MAKING IN CRISIS MANAGEMENT

This development from simple decision-making towards applications with more decision-making power, perfectly underlines, that it is time to think about how AI can affect decision-making processes in crisis management. The empirical findings showed, that currently, there is no “focus on the specific application of AI to crisis management, such as research in the context of natural disasters, etc. [yet] and you probably will not find that in any of the major AI labs”, as respondent 4 stated during the interview. However, as the example, that for instance the nuclear sector is asked, “to use newest technologies” (interviewee 1) as much as possible in their operations, demonstrates, there is a growing interest of AI in its potential for the normal run of operations, but also for crisis management.

When asking for the identified important characteristics of decisions in the context of crisis, i.e. speed vs. comprehensiveness, it came clear that there are already ways of AI to cover and balance those two parameters. However, it should not be overlooked, that there are also known limitations existing.

To first focus on the identified possibilities of AI for decision-making processes in crisis management: in the light of balancing those two factors, interviewee 4 illuminated: “as a programmer you can decide to give up one for the other parameter, decide in which relations those two parameters should be […]. For example, you could state that it is 10 times better to make a decision after a longer time than to make a quick decision with less information. That’s possible”. The interview with expert 6 led to the idea to apply the mathematical “optimal stopping method” in order to solve this difficulty. It is a method used for decisions, where it is unclear when to finally choose among decision alternatives. The aim of this method is to maximize the expected reward. The algorithm is based on the idea to divide the decision-making process into 2 phases, namely a looking and a leaping period. After 37% of the crisis period, until a particular decision has to be made, the algorithm chose the alternative which was better than all the alternatives seen during the looking period before, regardless how much information the algorithm gathered before.

Furthermore, focusing on the benefits, the interviewed experts are all on the same page, that AI nowadays is “fast”, capable to “processes billions of data” and “delivers reliable
data, when the data is right” (e.g. interviewee 5). Thus, the execution of AI agents for decision-making is “very cheap [...] super fast and efficient” (interviewee 4). To interviewee 2, “the main benefit of AI is managing multifactorial data” and thus it will relieve humans when there are situations “where there is too much information for the human brain” (interviewee 3).

Also, AI is, as interviewee 4 pointed out, already well developed and applied in the case of abnormality detection, which is identifying abnormalities and building patterns and finally making decisions based on the data. Such abnormality-detection services are already available on the market today and according to interviewee 4, it “works very well”. He personified his belief by the argumentation of “just the fact that there are companies, more than one, selling this service or product, it is actually a good proof that this development of AI is quite advanced [...] much more advanced than many of the other things we talked about”.

Lastly, “the strength of AI [...] not dealing with emotions” was mentioned by interviewee 3. In this case, as “it it’s an advantage, it’s also its drawback” (interviewee 3). Especially interviewee 6 pointed out, AI does not have any intuition. He made use of a self-driven Uber-cap, who recently killed a pedestrian in March 2018. However, interviewee 5 stated that “AI does not need any intuition because it is data driven”. He exemplified, “it is all about rewarding, learning in the same way as children do”. And as it is widely known, a child’s future is highly dependent on how the child grew up.

Closely related, AI is limited by potential data manipulation: if you treat a child to bad behavior, it will not know that it is bad behavior. In other words, interviewee 5 enlightened, “if you take data to train the AI, you do not know if the data is manipulated. There is a whole field of research that deals with attacks on neural networks. For instance, there was an AI which should identify turtles. Researchers printed the turtle’s shell with patterns of weapons. The AI finally recognized the turtle as weapons. The research area deals with what one can do to outsmart such mistakes”.

Another disadvantage of AI is to not have ethics (interviewee 1). As the example of the dam already showed, AI always makes rational decisions, which is not always the from an individual perspectives' desired one. The example, out of the automotive industry, which is recently focusing on the development of autonomous driving, underlines this fact. It leads in the key question of: who “will buy a car which will sacrifice the persons in the car instead of the one on the pavement?” (interviewee 1). Because in some dilemma cases, the AI in the car program will have to decide whether to kill the occupants of the car, or the persons on the pavement. Programmers will have to answer the question “how will we put ethics in machines?” (interviewee 1).

Interviewee 3 demonstrated this opinion by using a quite similar example, saying that if humans let an AI make the choice between killing one person or 10 persons to solve a situation, it will calculate easily that only one person should die, to save the 10 others, and the choice would be done very quickly. This example, and also the introduction examples of Volkswagen, bring the responsibility issue: if a human would have to make this choice, he would have make it with conscience and with weighting his responsibility. In brief, human seems to be irreplaceable “not [only] for the quality of his decisions, not for his genius intuition, but because at the end, he is responsible” (interviewee 1). Interviewee 1 said that “it is still the boss of the power plant who will decide to connect or disconnect something”, when taking the example of a nuclear power plant. Before democratizing the use of AI, regulators have to arbitrage to know “who will be responsible” (interviewee 1), who has to go in prison, as a consequence of decisions made by an AI agent.
In addition to the responsibility issue, AI experts see limits in fear and trust issues. Interviewee 3 stated, “AI can’t help in situations where leadership and argumentation are needed”. As seen earlier, followers need to understand why a decision is taken, only by offering explanations, crisis teams will keep their coherence. These issues are closely linked to the lack of understandable machine learning systems. Interviewee 4 exemplified, today, it is “easy for an AI to say if it is a monkey or an apple [on the picture]. But if you ask why did you come to the decision that it is an apple and not a monkey, then no AI can deliver any explanation for that”. Even if the findings of respondent 4 show, that in the field of understandable machine learning systems, “there is a lot of research going on and there are already some promising approaches”, however, “there is still nothing tangible yet”. Therefore, reasoning decisions is a subfield of decision-making processes, which cannot be covered by AI yet as one “cannot explain the decision-making processes” (interviewee 5).

Another important fact is, that the technology of AI is highly dependent on the initial trainings data, leading to the question of “how to make a good decision in an environment where you have few examples and training data?”. Interviewee 4 elucidated, AI can “make decisions based on empirical data [and] [...] there are very convincing results when decisions are based on empirical data”. He added, but AI needs to “repeat about 100,000 times”. Thus, the training of an AI is not efficient nowadays, as AI “learns very, very slowly”. Putting it into a nutshell, there is the necessity of available data, and on the other hand to the necessity of time to train the AI until the technology is able to improve itself. Interviewee 4 concluded, AI will “never have to think long. It really depends on the restriction of the time-consuming learning process”. To ensure data collection, interviewee 4 figured out, organizations must “work with AI constantly”, rather than just in crisis situations.

Finally, also due to the lack of the time-consuming learning process, the limits of AI are also salient in its inability to go further the ‘known’. Interviewee 5 exemplified this by stating “one of the biggest drawbacks [at the moment] is that if AI has never seen a case, [it] can not solve it [...]. If you always drive right, then it can never turn left”. To give another example, an AI model has been recently created to help to predict the Seine flood level which happens every year in Paris (interviewee 1), since “there is a really high number of parameters to consider”. As interviewee 1 said, “the model was working quite well in known situations” but some new parameters had to be add to the model, for which no previous data was existing, and eventually the model failed, and people who designed the AI “were really disappointed”.

All in all, the experts concluded, that for now, it is still “not possible to let an AI manage” (interviewee 1) a crisis. According to interviewee 2, “there is always a man to press the [final] button”. Human intelligence is required to solve crises, but from the crisis experts’ perspective, AI is already considered as an “additional intelligence” (interviewee 2), which will greatly help humans. To them, AI presents some unique characteristics, that make it extremely valuable for this kind of events when comparing it to humans.

### 4.1.8. SUMMARY OF FINDINGS

In fact, the interviewed experts agreed that “it is not possible to consider AI as a substitute of humans”. (interviewee 2) for now. However, it came also clear, that humans have limitations, especially in the context of rational decision-making, which can be balanced out by AI. Interviewee 1 summarized, “AI is perfect to drive a car, to deal a crisis, but we will have to settle rules at one point”. In sum, AI can and will affect organizational contexts, and in particular crisis, but there are also limitations existing. In order to discuss
how AI can affect decision-making processes in crisis situations, all findings are briefly summarized in Table 4.

<table>
<thead>
<tr>
<th>Sections</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of decision-making in crisis situations</td>
<td>- Multifaceted nature, with the following main features: good timing, feasibility, quality of information, short- and long-term effects</td>
</tr>
</tbody>
</table>
| Teamwork approach for decision-making | - It is better to involve two teams (one close and one far from the situation) in crisis in order to don't lose the overview and to have an independent voice  
- It is important to maintain the communication flow |
| The importance of training            | - Training is necessary to make the most pertinent decision  
- It will help to increase the sensitivity for weak signals to prevent crisis  
- It will create reflex actions and routines to behave immediate as well as appropriate |
| The controversial role of intuition   | - It is questioned whether intuition is beneficial in crisis situations or if it is adverse for industrial processes  
- Contra: Intuition can lead to a lack of followership, can bring more uncertainty to situations, negative emotional biased decisions  
- Pro: The Hudson example and the Fukushima example showed that in some cases, intuition can be a winning point |
| Human decision-making abilities and limitations | - Humans possess the abilities to influence and to add new input data at any moment in their thinking process  
- Humans can easily make a "step outside the picture"  
- Humans can reason and explain their decisions made  
- Humans are biased by their perceptions, which can lead to suboptimal decisions  
- Humans have a lack of analytical skills |
| AI on decision-making                 | - Decision-making is the core of AI  
- AI development is already very good in simple and binary decisions  
- AI is used for simple problems, to ensure a fast learning process and development  
- AI is used in more complex situations  
- AI gets more and more decision-making power, like for example: risk modeling for banks, predicting criminal recidivism, diseases detection, or output optimization with multifactorial input parameters  
- AI is expected to become an industrial evolution |
| AI on decision-making in crisis management | - Growing interest for AI and its potential for crisis management  
- Benefits i.e. abnormality detection for the pre-crisis stage, huge data processing, fast, emotionless and efficient decision-making  
- To balance comprehensiveness and speed, the 'optimal stopping method' could be useful  
- Limitations: need of massive initial training data, time consuming learning process, no understandable machine learning systems, no intuition, risk of data manipulation, no ethics, responsibility issues, trust and fear issues, and difficulties to go further the 'known'  
- Organizations have to work with AI constantly, not just during crises |

**Table 4: Summary of main findings**
4.3. CONCLUSION FINDINGS

It came clear that for crisis managers, a good decision consists of the 4 characteristics timing, feasibility, quality of information and a long-term vision. Timing is thereby to make decisions in the right time - not too early, not too late. Moreover, the feasibility of decisions was identified to be important. That is, good decision-making is not just about identifying the optimal decision among different alternatives, but also about the appli- cability of the decision itself. Next, as humans are not able to retrieve and process a huge amount of information, especially not under time pressure, the quality of information also plays a role in terms of good decision-making in crisis situations. Lastly, it came apparent, that the long-term vision, meaning to not just focus on the direct effect, but also on indi- rect, resulting consequences later on of decisions made, is important. Nowadays, achieving such a good decision means the necessity of rationality and intuition. From special importance in the context of intuitive decision-making, experiences (i.e. reflex actions/routines) could be identified. Contrary, emotions should not play a role in the decision-making process in crisis management according to the analysis of empirical find- ings. Lastly, the perception of humans about situations clearly differs from human to human.

4.4. DISCUSSION

The contribution of the study at hand comes apparent when putting together both, the literature and the empirical findings, which will be discussed in the following section. Thereby, like Lewis and Ritchie (2003, p. 263) indicate, the discussion section in qualitative papers remains quite free compared to quantitative studies, since there is no clear frame to follow.

Luckily, after reviewing the literature, the fact that we are dealing with an exploratory study got confirmed by the empirical findings as there is a common interest in the potential of organizational AI for crisis management, but it is barely researched, and thus, not widely applied yet. Furthermore, the findings showed that focusing on decision-making as a first narrowed sub-field of crisis management was a good choice, as “decision-making is [...] the core of AI” (interviewee 4) and as in crisis situations, the way how manager make decisions is even more important than in the normal run (Pearson & Clair, 1998, p. 72; Walumbwa et al., 2014, p. 284). Thus, decision-making is crucial for both fields of interest.

To guide our efforts, bringing together decision-making processes in crisis situations and AI, figure 5 illustrates the gained results from the literature about essential characteristics, i.e. speed and comprehensiveness. To remember the longer a manager is searching for an optimal, rational solution, the larger is the risk that the crisis will run out of time and control (Rosenthal & Kouzmin, 1997, p. 294). Thus, those two factors make a decision under crises to an optimal decision as soon as they are balanced appropriately. The overlap, marked in green, was therefore concluded to be the optimal decision in crises.
4.4.1. **The Balancing Act of Comprehensiveness & Speed**

As discussed in the literature review, humans make use of rationality and intuition (Khatri & Ng, 2000, p. 77) in order to manage the existing trade-off between decision speed and decision accuracy (Dane & Pratt, 2007, p. 33). A part of the literature as well as the empirical findings showed that rationality is clearly from importance, rather it is the question in what degree rationality should influence decision-making processes in crisis management. Contrary, when it comes to the intuitive decision-making process, the findings gained through the study are not confirming the literature undoubtedly. Both will be discussed in the following in detail.

**4.4.1.1. Rationality**

To first focus on the remaining question about rationality: one school of thought is pleading for a not too rational approach in uncertain and changing situations (Fredrickson, 1984, p. 445; Fredrickson & Iaquinto, 1989; Fredrickson & Mitchell, 1984). Paradoxically, a second school of thought is defending a careful and analytical scrutiny when addressing such situations (Miller and Friesen, 1983, p. 223), which implies a more rational approach. To recall, rational decision-making is the direct result of comprehensive information gathering and processing (Fredrickson & Iaquinto, 1989, p. 516): a process, following a sequence of logic steps (March, 1994).

Thus, according to the latter school of thought, there is a belief that distinct rational decision-making skills are required to tackle the complexity of crisis decision-making (Sayegh et al., 2004, p. 185). The empirical findings showed that humans are limited in exactly this capability as they show a lack in processing an amount of comprehensive information needed for rational decision-making. In this respect, the empirical findings assert that AI is advantaged compared to humans because of its ability to process huge amount of data.

Moreover, the empirical findings pointed out that human intelligence is inadequate, or at least less sensitive than AI when identify abnormalities by weak signals of incoming crises, which also requires a certain rationality. This has been demonstrated by the example of 9/11 (part 4.1.3.), where humans ignored weak signals. Thus, AI technology can be seen as a clear asset for humans in the pre-crisis stage defined by Coombs (1999). All in all, AI appears clearly superior in terms of rational decision-making processes.

**4.4.1.2. Heuristics**

Coming back to the fact that humans are always restricted in accessible, but also processable knowledge and data because “it is unbelievable [...] that humans always have a
conception of what would be optimal in complex situations” (Simon, 1993, p. 396). The empirical findings suggest that managers must therefore filter information and focus on quality instead of quantity. This is what Simon (1979, p. 501) presents as “bounded rationality”. To find a satisfying solution, even without quantity of information, simple heuristics are used by humans. In brief, this “less-is-more-effect” (Gigerenzer & Gaissmaier, 2011, p. 453) is covered by both: literature and findings.

In the light of AI, and in the context of decision-making processes in crisis management, it is the goal of supervised learning systems, to build heuristics (Maini & Sabri, 2017, p. 16). The benefit of heuristics based on AI compared to human intelligence comes clear, when pointing out, that heuristics built by an AI is about filtering the really important information out of all available information, whereas heuristics of humans are a solution in order to deal with their lack of quantitative information.

Lastly, the empirical findings revealed, decisions based on heuristics are still decisions based on available information, even though they might be incomplete in the case of human intelligence. Thus, it came apparent that the application of heuristics, a succession of filtering information, is rational, whereas just the emergence of heuristics is irrational in case of human. Thus, against the structure of literature findings, we decided to see heuristics as something in between rationality and intuition.

4.4.1.3. Intuition

According to the literature, decisions influenced by intuition are more opportune in unstable environments than in stable ones (Khatri & Ng, 2000, p. 62). The empirical findings, contrary, question whether intuition is beneficial in crisis situations or if it is adverse for (uncertain) industrial processes.

To discuss the raised ambiguity, putting first attention on the way of thinking that intuition can be understood as “intuitive intelligence” (Jung, cited in Jarrahi, 2018, p. 3), positively contributing to manage decision-making processes in crisis situations. In the literature review, “Steve Job-” decisions were used as an example, as he became well-known for making successful intuitive decisions (Jarrahi, 2018, p. 4). Of course, this illustration itself is not an example for crisis situations, but it shows that intuition can lead to successful decisions. That this is also the case in crises, and it was exemplified by the Hudson river landing (part 4.1.3.) and the Fukushima example (part 4.1.4.), mentioned in the empirical findings.

As extensively derived in the literature review, emotions and experiences are a part of intuitive decision-making processes as they allow to make better decisions in crisis situations (Walumbwa et al., 2014, p. 287). Sayegh et al. (2004, p. 186) stated, that “manager with experiences may have a better awareness or a bigger repertoire of possible causes”. They create a “comfort zone”, where managers may lose their fears and fulfill the need of quick decision-making (Pearson & Clair, 1998, p. 70). Such experienced based knowledge can be composed through training and the involvement in similar events to current situations (Sayegh et al., 2004, p. 185). Also, within the empirical findings, training was figured out as necessary to take the most pertinent decision. Here, especially reflex actions and routines could be pointed out to be from special importance. When it comes to AI, the technology itself is also based on input data and learning from experiences and repetition.

At the opposite, the other way of thinking assumes that intuition is “not meant for industrial matters”, rather a rigorous approach is appropriate for crisis management. As the
empirical findings showed, intuition can bring more uncertainty to already uncertain situations and humans may be biased by their perception, experiences and emotions. In the context of experiences, especially the example with the “ugly break up with the ex-boyfriend” (part 4.1.5.) illustrated the potential negative effect of human biases perfectly.

In terms of emotions, the literature review showed, that processes become more emotional during crises. However, it was the theory of the last decades that emotions should be best kept aloof (Sayegh et al., 2004, p. 181), which is nowadays replaced by the opposite. Thus, the empirical findings to consider intuition as not appropriate for crisis management is in line with the theory of the last decades. As the example of the “hyped athlete”, who gets hyped up for a big match, and thus, the performance exceeds the normal performance (Sayegh et al., 2004, p. 192), shows the positive effect of emotions, they can also lead to suboptimal decisions, as the ‘dam-example’ (part 4.4.5.) exemplified.

In terms of suboptimal decisions, the experts separated ethics from emotions, which mostly can be explained by a trust issue in artificial intelligence but also by the human feelings related with obviously “right” (i.e. rational, logical) but wrong feeling decisions. By stating that ethics, against all assumptions about emotions, are however important, the “confession” to ourselves as humans makes clear that the modern approach is probably right, at least not wrong. To put it differently, maybe the approach to see intuition as negative, would be optimal, but humans themselves are not perfect, they cannot make decisions against their heart all the time and can never switch off emotions completely. Based on this knowledge, it comes clear that the biggest advantage of AI compared to humans is that weak AI agents do not have emotions. What strong AI will be capable of is not worth to consider yet, as the development is far away from its realization.

Summing up, in the context of experiences, the literature review got confirmed but even more specified: experiences are important - but especially the right experiences, not mainly randomly made experiences, more intentional trained experiences and routines, which can be understood as most closely to rationality. In this context, it should be clearly pointed out, that when it comes to reflex actions, AI is faster than humans are, thanks to its fast and efficient decision-making process.

4.4.1.4. Summary comprehensiveness and speed

All in all, rational decision-making skills are indispensable, even though there is no common opinion to what degree they are from importance. Not knowing how important rationality is, leads into another disagreement between literature and (one approach of the) empirical findings concerning intuition, as humans need both to manage comprehensive and quick decision-making. The convergences can be explained with the fact that so far, only human intelligence was taken into considerations. Bringing AI into the picture changes the capabilities to balance speed and comprehensiveness as they are capable to process comprehensive data fast. From this perspective, rationality plays an even bigger role than expected after the literature review. In sum, AI is better when it comes to solve the balancing act. The optimal stopping method could be found out as an appropriate mathematical method.

4.4.2. Model of successful decision-making in crisis management

After conducting and systematically analyzing data thanks to the general analytical procedure (see part 3.7.), figure 5 got extended by two factors for good decision-making in crisis situations. The resulting model, illustrated in figure 6, illustrates one big contribution of the thesis project at hand. In this model, the optimal decision can be seen as the
overlap of comprehensiveness, speed, long-term effect as well as the immediate short-term effect, again, marked in green.

Figure 6: Model of successful decision-making in crisis management

According to the empirical findings, the multifaceted nature of successful decision-making in crisis management is embodied by good timing, feasibility, quality of information and short- and long-term perspectives. To explain the development of the model: timing is exactly what speed and comprehensiveness is about, namely to make the decision in the right time - not too early, not too late. The importance of quality of information is included in comprehensiveness, due to the human’s “bounded rationality” (Simon, 1979, p. 501), as individuals are limited to access and process the quantity of information available. When it comes to feasibility and the long-term vision, two characteristics, which were not covered in the literature review, come into the big picture of decision-making processes in crisis management. Feasibility thereby means that it is not just about optimal decision-making itself, but also about the ability to implement a decision made. To exemplify, without feasibility, there is no action power. Consequently, the desired effects will be worse than expected or will even not occur and thus, the decision will not be optimal, neither in the short- nor in the long-run. Considering long-term vision, decisions should not just focus on the direct effects of a decision, but also on indirect, following decisions, paying attention to waterfall consequences. As the title already suggests, this factor is included in the last characteristic called ‘long-term effects’. The added two influence factors, short- and long-term effect, will be explained and discussed in the following section.

4.4.3. SHORT-TERM EFFECT & LONG-TERM EFFECT

As these effects were identified through the empirical study, there are not that many findings from the underlying literature review existing, against which this part can be discussed. But, it was already figured out in the literature, that it is not only decision-making itself which is from interest, also the implementation of decision-making has to be emphasized, as it is the basis to find actions, that will lead to the desired outcome of a decision (Simon, 1993, p. 393). Based on this belief, it is even worth to discuss AI and decision-making processes in crisis management, mainly based on the empirical findings.
From the human perspective, to match the remaining overlap as good as possible, the idea is to involve two teams for decoupling decision-making from decision implementation. Thereby, one team is focusing on the operational part of decision-making, i.e. the implementation of decisions, while the other team is concentrating on the strategic part, which is finding, weighting and choosing alternatives. In the light of AI, it can be thinkable that humans could still be responsible for the action taking, meaning the final decision-making, while AI agents could be used to ensure the comprehensive ‘bird perspective’ and to recommend among different alternatives. By doing so, short-term and long-term effects, direct and indirect consequences, would be ensured by humans and AI’s benefits discussed for comprehensiveness and speed, would be used.

As a matter of fact, this idea is restricted by the lack of reasoning as AI is not able to explain or reason its decision. Thus, decisions made by an AI agent, based on a huge amount of data, are optimized, however, the operational team would not be able to scrutinize. Humans, compared to AI, still have the ability to reason and moreover, to influence others.

When it comes to influencing others, the literature review showed that this is the core of leadership, as it is defined as “the quality of obtaining results from others through personal influence” (Maylor, 2010, p. 268). Thus, humans are able to lead, which is according to Drucker (cited in Maylor, 2010, p. 266) about “doing the right things”. Contrary, AI, as is highly dependent on initial training data and with its current state of the art still applied to narrowed problems, is seen as “doing the things right”. According to the literature review AI is thereby defined as being able to manage situations (Drucker, cited in Maylor, 2010, p. 266) rather than to lead. Altogether, the ability of AI to “only” manage, leads into a lack of followership.

Closely related and in line with the literature and the findings, another important limit of AI “is trust issues [...] either by misunderstanding, by suspicion, or even fear” (Ransbotham et al., 2017). As the literature review showed, when considering crisis, trust is an even more important matter to care about (Natorski & Pomorska, 2017, p. 67), as again, issues will apparently lead into missing or wrong action taking because a lack of trust will decrease the productivity and the quality of the work (Sabatier, 2014, p. 3). In sum, the lack of reasoning, of followership and the trust issues together are affecting the short- and long-term effects of decisions made.

When considering long-term effects, the empirical findings showed, for humans it is easier to make a step besides the particular situation and to add data, than it is for weak AI. Furthermore, the learning process of human is much faster compared to AI. Lastly, as mentioned in the findings, there is the lack of responsibility existing. All points considered, it is almost impossible for today’s AI agents to be aware of and to focus on a long-term vision.

Even though there are a bunch of limitations for today’s AI agents existing, the example of smartphones (part 2.2.1.) shows that, even if humans are always scared about unknown, this obviously can turn quickly into normal, and the lack of trust can easily disappear. Based on this understanding, organizations should be aware that it is important to implement AI as soon as possible, so that humans lose fears about this technological development.

To conclude the section, due to AI’s lack of reasoning, followership, trust and the time-consuming and data-intensive trainings process, humans are more capable to ensure the implementation of direct actions as well as being aware of indirect consequences.
4.4.3. AI AND HUMAN INTELLIGENCE IN THE MODEL

After the discussion of the literature review and empirical findings, it can be summarized, that humans are better in the context of short-term and long-term effects, while AI can better balance the trade-off between comprehensive and quick decision-making in crisis situations. Summarizing, figure 7 illustrates the abilities of human intelligence (HI) and artificial intelligence (AI) in the developed model for “successful decision-making in crisis situations”.

![Figure 7: HI and AI in the model of successful decision-making processes in crisis management](image)

As it can easily be seen, neither AI nor HI are able to match the overlap, assumed as the “optimal” decision in the context of crisis management. While AI with its current state of the art is especially not able to cover long-term effects, this is a factor where HI is notably good at. When considering the parameter ‘speed’ it is the opposite. By this, it comes clear, that AI’s abilities can balance out limitations of HI, whereas HI can equal out limitations of AI. In brief, AI and HI are kind of complementary in their abilities and limitations. Thus, based on our model, applying AI on decision-making processes in crisis management, can be concluded to be beneficial as a combination of both will match the overlap better.

4.4.5. HOW AI CAN AFFECT DECISION-MAKING PROCESSES IN CRISIS MANAGEMENT

Based on this understanding, the remaining question is, how AI can affect decision-making processes in crisis situations. Based on the whole thesis project: a deep literature review, a good choice of methodology and qualitative findings, we will answer the question in the following. Before, two things should be clearly figured out: (1) it is assumed that the reader has the knowledge from at least this chapter, better from literature review, findings and discussion, (2) as the work is an exploratory study, based on multiple case study, the answer gives a broad, rather than a deep overview. The goal is to offer a first insight in possibilities of AI on crisis management. To guide these efforts, making the answer more tangible, the outline will be presented in short-, medium-, and long-term perspectives.
As table 5 shows, with the current state of the art, AI is not applicable to decision-making in crisis management yet. Thus, in the short run, humans still keep their role of being the decision-makers as well as the one implementing decisions. The most obvious case is that machines offer humans an additional memory, thanks to semi-autonomous decision-making support system, storing data (Witten et al., 2016). However, as a bunch of examples pointed out, AI is already today used for more and more complex and decision-sensitive judgements. As to train an AI is time-consuming and a huge amount of initial trainings data is required, it can be recommended to all organizations to start gathering crisis data as soon as possible, to be able to apply AI on decision-making processes in the near future and to be best prepared to the “growing child” getting an adult.

This is just realizable when AI is also applied within the daily run of organizations rather than just for crisis cases. By doing so, even more data will be collected, and abnormality detection will be realizable, which is especially useful for the prevention of crises. Considering the second crisis stage, namely crisis management AI could be used in a team-work approach in the medium-term, which will also decrease the existing trust issues about AI. By ongoing training of AI for decision-making processes, the semi-autonomous AI agents will become more and more autonomous, as they are more and more able to learn by themselves.

Lastly, the long-term is of course hard to predict as the development of AI is fast. Nonetheless, some realistic conclusions could be drawn. First, as the research in the field of understandable machine systems is already going on, some tangible results can be assumed in the long run. This will, in turn, open the possibility to make an effective and accepted decision-making in organizations. This is, the banking sector, the law sector and the pharmaceutical sector, will be expanded by more industries using AI for decision-making processes. Even if crisis management can be expected as one of the last organizational areas, where AI will be really used for decision-making, as the consequences itself are immediate, it can be said, that the benefits of combining AI and HI are already

<table>
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<tr>
<th>Short-term</th>
<th>Medium-term</th>
<th>Long-term</th>
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<td>- Simple binary decisions</td>
<td>- AI for decision-making in organizational daily run: more available data</td>
<td>- Understandable machines learning systems</td>
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<tr>
<td>- Human as decision-maker</td>
<td>- Abnormality detection for pre-crisis stage</td>
<td>- Effective decision-making by AI agents</td>
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<tr>
<td>- Semi autonomous AI for decision-making</td>
<td>- Team approach: human as the final instance, AI as additional intelligence</td>
<td>- Application on crisis management: “right arm of human”</td>
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<td>- More and more complex and decision-sensitive judgement</td>
<td>- Training of AI for crisis</td>
<td>- Industrial revolution, will be everywhere</td>
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<td>- Data gathering for crises</td>
<td>- Change from semi-autonomous to autonomous AI agents</td>
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<td>- Strong AI?</td>
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**Table 5: Short-, medium-, and long-term perspective of AI on decision-making in crisis management**
identified, and thus, a change caused by AI in the picture of crisis management is highly probably in the long run. In overall, AI is an industrial revolution and will change business. If and when strong AI will be realized is a remaining question in literature which will not be answered within this study as this would be purely speculative. But this study can enlighten the mentioned revealing convergence in the literature and the identified two schools of thoughts, which will be pointed out in the conclusion.

5. CONCLUSION AND CONTRIBUTIONS

The aim of the following chapter is to answer the remaining convergence and to take place to one of the two existing schools of thoughts, discussed in the beginning. Moreover, the theoretical, managerial, societal, and practical contributions of this study will be pointed out. Then, an evaluation of the thesis project will be conducted thanks to the reliability and validity criteria, as well as the trustworthiness criterion. Finally, limitations of the research and future research possibilities will be discussed.

5.1. CONCLUSION

The main ambition of this study was to bring a better understanding and an improved knowledge of the possible use of AI in the manner managers are taking decisions under crisis situations. Thus, the research question has been defined as “how AI can affect decision-making processes in crisis management”, which got answered in the final discussion part. The study has been conducted in a recently growing interest and fast development of AI the past few years, in addition to a constant concern for crisis management, since organizations are increasingly facing more frequent and more potentially devastating crises (Hwang & Lichtenthal, 2000, p. 129).

First, it has been identified in the literature that in order to manage a crisis successful, decision-making processes in crisis management need to balance comprehensiveness and speed. Through this thesis project a model could be developed that adds two criteria, namely short- and long-term effects. Taking these two supplementary factors into consideration when taking decisions in crises, helps to improve stability for the organization in the long-term, while ensuring feasibility in the short-term.

Secondly, both, crisis and AI experts, have expressed some limitations in the capacity of humans to make good decisions, especially in situation of crisis, due to their unavoidable lack of control of their emotions, and more generally to the significant influence of their intuition on decision-making, as well as their lack of analytical skills. Even experience, which has been described as a clear human asset when speaking about crisis management, show some limits, by sometimes biasing the perception of the situation. Simultaneously, all the experts have highlighted the potential use of AI technology in crisis decision-making, for its capacity to compute efficiently and accurately massive amounts of data, with a rational approach, devoid of any emotional or intuitional influence. However, even if AI agents seem to present a lot of assets when imagining their use in crisis situations, they also show some clear limitations and challenges. In brief, it was concluded that AI can be seen as a complementary intelligence to humans.

Finally, a combination of human intelligence and artificial intelligence could be figured out as beneficial. In this way, the potential use of AI for decision-making processes in crisis management can be predicted by dividing possible applications for the short-, medium-, and long-term. It has been found that AI is not implementable for decision-making
in crisis management as it exists for the moment, mainly for trust and legal issues, as well as lack of crisis data. In a medium-term perspective, AI agent can be imagined being part of the decision-making processes under crisis situations as the ‘right arm’ of the manager, but also in a preventing and predicting role. Lastly, in the long run, as development of AI are recently increasing exponentially, it can be foreseen that AI will play a bigger role in crisis management, by maybe being implemented for taking decisions or being in command in minor crises, even if crisis management will probably be the last field of application invested by AI, regarding the complexity and the uniqueness of crises. Even if AI can be forecasted to be a great help for managers when dealing with crises, humans are for now the final decision-makers. However, if managers decide against AI suggestions or make evil decisions (Gundel, 2005, p. 108), like in the Volkswagen example, AI will not be able to solve all the situations.

After all, considering the two school of thoughts, this study confirms the belief of Miller and Friesen (1983), who argued that especially in uncertain situations, a greater degree of rationality is required and thus, AI is even more helpful and should be applied. This study concludes with the opinion that both, rationality and intuition, is important to manage crises, as it will be a combination of HI and AI being responsible for crisis management decision-making processes. However, the degree of rationality is higher than expected in the beginning. Related to this surprise, it could be identified that even within the intuitive decision-making skills, the more rational influence factors (i.e. reflex actions and routines) are from special interest while others should be eliminated as much as possible (i.e. emotions). Thus, AI and its rational decision-making skills can definitely improve decision-making processes in crisis management, while balancing out the limitations of human intelligence. However, due to trust issues, the lack of available input data, the time-consuming training and lastly due to the immediate and extensive consequences of decisions made in such organizational environments, human should, at least in the foreseeable future, be the last instance. In brief, according to our study, AI will not be in full responsibility of decision-making processes in crisis management, but it will be a beneficial support for decision-makers in authority, improving the quality of decision-making.

5.2. CONTRIBUTIONS

5.2.1. THEORETICAL CONTRIBUTION

This thesis has explored the potential use of AI technology in decision-making processes in crisis management. Literature was existing on both sides of the subject, which are decision-making processes with AI and decision-making processes in crisis management. However, no existing literature has already mentioned the intersection of these two fields. Interviewing both, crisis and AI experts, allowed to have a broad picture of this junction, to consider insights and perspectives of both sides, in order to have the clearest idea of the state of the art of AI from the AI experts, and what are the needs of crisis management and the fears of using technology of crisis experts.

Besides, this study contributes to the field of decision-making processes in crisis management. As the main contribution, the model of successful decision-making in crisis management could be developed based on influence factors identified in the literature (comprehensiveness and speed) and two additional crucial factors found, i.e. short and long-term effects. Thus, combining these four factors altogether appears to be the optimal way to make a good decision in crisis contexts.
Additionally, considering the role that emotions are playing in decision-making processes in crisis management, the existing literature review stated emotions as a positive human factor to make good decisions. However, even if humans can definitely not turn off their emotions on request, it has been found that emotions are badly perceived in the decision-making processes by crisis experts, since they usually induce bad decisions, or even disasters.

5.2.2. MANAGERIAL CONTRIBUTION

From a managerial perspective, this study is relevant for any organization, as any organization is potentially impacted by crisis at some point. Moreover, as AI will change how organizations work, this research suggests some measures to take in different time horizons, to be able to use AI as soon as this technology will be enough developed to also be used in crisis contexts. It is recommended for any organization to start with massively collecting data in crisis situations, and more generally also in the normal run of operations, since AI technology needs a lot of trainings data to give more accurate and relevant answers. In the same way, it is suggested for any organization to also implement AI agents beside crises as the more people will be acclimated to use it, and the more the AI agent will be fed with data, the better will be the suggestions in a crisis period.

In addition, the thesis project at hand suggest a clear image of what a good decision under crisis should take into consideration, and how this good decision can be made. The combination of speed, comprehensiveness, and short- and long-term effects seems to be the optimal way to made successful decisions to solve a crisis, as well as having a team approach as a crisis response. However, it is maybe important to remember that crises are stressful situations, with the weight of responsibilities and time pressure felt by managers. Even if some specific conditions for optimal decisions have been highlighted in this paper, it is highly complex for managers to be able to have a clear mind and think about this model in the middle of a crisis. Thus, having a real training and preparation internal policy for managers, in order to develop routines and reflex actions, like automatically using the model exposed earlier, should be on the top of the list of the elements to implement for any organization.

5.2.3. SOCIETAL CONTRIBUTION

From a broader perspective, this study contributes to the society in general since it aims to improve crisis management of organizations. Whether the crisis occurs in a public or in a private organization, the impact of some crises can exceed the boundaries of the organization itself and can affect or endanger individuals and organizations around. By better preventing and managing these events, crises’ impact could be drastically reduced, or crises could even be hindered before they actually occur.

Besides, this paper is also putting light on the rising debate about ethics and responsibility concerning the deployment and the use of AI agents in the daily life. These issues have been highlighted in this paper as particularly important by several interviewees when considering AI. Even if people get used to AI agents when using them for a certain amount of time (like computers or smartphones) and even if they do not consider these items as AI technology, AI agents are more and more numerous in society life and are achieving tasks with increasing potential consequences (like autonomous cars). Thus, a frame for the use of AI technologies has to be clearly settled and updated alongside AI development, to define a clear regulation, limits, but mainly to solve the ethics and responsibility issues.
5.3. TRUTH CRITERIA

In the final phases of the process of a business research, the researchers have to appraise the overall quality of their work. Thus, in the next section the expected requirements for quality for qualitative business researches will be compared with this study as a whole, to be able to judge its truth criteria. While reliability and validity, which are both criteria for quantitative and qualitative studies, will be considered in the first instance, trustworthiness will be assessed in the second instance, as it is presented as a more specific criterion for qualitative research (Bryman & Bell, 2011, p. 395).

5.3.1. RELIABILITY AND VALIDITY

According to Collis & Hussey (2014, pp. 52-53), qualitative business researches truth criteria are mainly evaluated by two main principles, which are reliability and validity. First, reliability for business studies is referring to the degree to which the way the research was conducted will provide steady results (Saunders et al., 2009, p. 156). To insure this, Saunders et al. (2009, p. 156) are suggesting that if the study has positive answers to the three following questions, the research reliability is validated: “Will the measures yield the same results on other occasions?”, “Will similar observations be reached by other observers?” and finally “Is there transparency in how sense was made from the raw data?”. While the research was conducted, it has been made sure to always take a step back from the study, to never be too subjective in the way to collect and analyze data, and in the way to present the results.

Additionally, truth criteria of qualitative business studies are also concerned by validity criterion. Saunders et al. (2011, p. 157) presents validity as “whether the findings are really about what they appear to be about”. It can be seen as the extent to which a certain experiment is relevantly designed to evaluate what the researcher wanted to test, but also the extent to which the conclusions of the research are displaying the core of the research (Collis & Hussey, 2014, p. 53). At each achieved phase of the research, it has been wondered whether or not the achieved part was in line with what was already written, and more importantly, if each additional part of the research was helping to answer the research question.

5.3.2. TRUSTWORTHINESS

As said earlier, trustworthiness is declared as a better criterion to assess qualitative researches (Bryman & Bell, 2011, p. 395) than reliability and validity. Trustworthiness can be seen as the combination of four factors, which are: credibility, transferability, dependability and confirmability (Bryman & Bell, 2011, p. 395).

Credibility has been described by Bryman & Bell (2011, p. 396) as the respondent validation, or member validation. Credibility for qualitative business research is concerning the correlation between what the respondents answered during the data collection, and how the researchers have restituted their answers in the research. To make sure that the answers of the respondents during the interviews, some of the respondents’ answers have been reformulated or the interviewees have been asked for more details if the answer was not clear. To get the approval of the respondents about the finished research and how their answers were understood, it has been agreed to send the respondents the research once finished.

Then, transferability accounts for the extent to which results can be transferable from one context to another one (Bryman & Bell, 2011, p. 398). Qualitative studies are expected to have a deep and strong focus on a specific subject of study, and therefore, researchers
are advised to achieve a thick description of the examined context (Bryman & Bell, 2011, p. 398). This research was based on the intersection of crisis management and AI about decision-making processes, and since almost no overlapping already exists in the literature about these topics, the exploratory feature of this research makes it hardly transferable.

After, dependability is characterized by a transparent behavior of the researchers about the manner they conducted the research, by the accessibility for any peers to evidence of the whole research process, such as “problem formulation, selection of research participants, fieldwork notes, interview transcripts, data analysis decisions, and so on” (Bryman & Bell, 2011, p. 398). Thus, records of everything that has been used have been kept, from the first notes about the searches done to find a topic, to the last notes made to elaborate the analysis from the findings. The research was mainly elaborated on computers, so different versions of each part of the research have been saved.

Finally, confirmability is concerning the impossibility for researchers to provide a total objectivity in their manner to conduct their qualitative study (Bryman & Bell, 2011, p. 398). This criterion is mainly regarding the data collection, which was made through interviews, and the way the researchers used and analyzed the answers of the respondents in the research. In order to interfere as least as possible with the answers of the respondents, interviews were conducted in the mother tongue of the respondents, either German or French. Then, their answers were transcribed from audios to written documents in the same language, to finally carefully being translated in English. Therefore, it has been ensured to not manipulate respondents’ answers by using them outside of their contexts.

5.3. LIMITATIONS

While conducting the study, except the subjectivity already discussed which characterizes any qualitative research, some limitations of the study have been identified. First, it has been conducted with heterogeneous respondents: both crisis and AI experts were coming from different companies and different sectors, and thus, they all have a specific context in which they developed their expertise. This limitation has been accepted since the conducted study was an exploratory one on the subject, and the limited amount of time to achieve the study did not give the possibility to look for a sufficient number of experts from a specific field or sector.

Secondly, as mentioned in the literature, crises are unique events and have multiple forms, causes, consequences and importance, which obliged a specific focus on each type for a total understanding of their distinct characteristics. In this study, no focus has been done on one specific type of crisis since there is no previous research on the use of AI in crisis decision-making in general. Thus, a broad study on all types of crisis have been preferred, to further suggest future researches on each type of crisis.

Thirdly, the fact that AI is a field in constant and fast development might lead to a quick obsolescence of this study. The technological advancement made these past few years in this domain have completely modified the way people are perceiving AI, and there are some chances that this domain will significantly evolve in the next few years as well, with the development of strong AI agents for example. However, this study can still be used to get a first overview of what AI could bring to crisis decision-making in some years.
5.3. Future Research

As mentioned in the limitations, further research could be done on how the use of AI technology can affect decision-making on the different existing types of crisis. Each crisis typology possesses its own characteristic, like in terms of salience, time, predictability, etc. Hence, the role of AI will be certainly different between these different types.

Moreover, it was figured out, that communication is from importance when managing a crisis successfully, but also, a transparent communication flow is crucial in the normal daily run of any organization. From AI perspective, it was pointed out, that AI has a lack of reasoning and still creates trust issues among human. Thus, further research could investigate in the research question of how AI will affect or even change communication flows within organization, or more specific in crisis management. It could be explored in which degree humans will be willed to communicate with an AI and if they will accept instructions made by AI agents.

Furthermore, as the development of AI is going on fast, it is even possible to analyze the same research question in a comparable small frequency of time and to always update the implications and possibilities expected within the short-, medium- and long-run.

Finally, future research could be conducted on the readiness of managers to accept the use of AI agents in the completion of their tasks. Most managers are already using computers and smartphones every day, which are intelligent agents, but they might be still reluctant to use smarter agents, like AI, which are able to make recommendations, suggestions, to have independent thoughts, and most of all, agents which might get right when humans can think wrong.
REFERENCES


APPENDIX

APPENDIX 1: GUNDEL CRISIS MATRIX

(Gundel, 2005, p. 112)
APPENDIX 2: INTERVIEW GUIDE FOR CRISIS EXPERTS

How artificial intelligence can affect decision-making processes in crisis management?

Goal of the study:

(1) find out what is really important in DMP in crisis management
(2) find out which experiences/fears crisis managers have with new technologies
(3) how AI’s technology can replace important features of DMP in a foreseeable period of time

1. Self-introduction
Hello, we are Pia and Guillaume and we are currently conducting a study for our master thesis in management at Umea School of Business & Economics in Sweden. First of all, we want to thank you for your participation in our work and for the time you will give us by answering some questions. We would like to mention that our study has received an ethical approval from our university, which implies that your participation is fully voluntary, and you can stop the interview at any moment without giving any reason. We will make sure that your personal data will be kept confidentially. There is no right or wrong answers. For some practical and ethical reasons, we would like to record the interview: would you agree if we do so? Finally, when answering our questions, don’t hesitate to give us examples, it will allow us to better understand your point.

2. General Information about Interviewee
(2.1.) What is your current occupation and how is it related to Crisis Management?
(2.2.) Have you been working in the field of Crisis Management? If yes, on how many years/companies/positions can you draw your experiences upon?
(2.3.) Why are you interested in the field of Crisis Management? Is there any particular case you remember? How did you deal with it?

3. Background information about the other topic
Short introduction of the concept of AI

4. Questions about Crisis Management

DMP in Crisis Management
(4.1.) We found out, that decision-making processes become more important in crisis situations than in the daily working environment. Moreover, we found out, that especially in such uncertain environments a trade-off between comprehensiveness and speed is existing. What is your opinion about that? Do you have an example in which you faced this dilemma? How did you solve this dilemma?
(4.2.) We decided to differentiate the DMP between rationality and intuition. Decisions based on rationality are thereby defined as direct results of comprehensive information gathering and processing, meaning that decisions are made after following a sequence of
logical steps, i.e. identifying alternatives, evaluation, choice. On the other hand, an intuitive DMP is based on human’s subconscious, where especially perceptions, heuristics, experiences and emotions become important.

(4.2.1) In crisis situation, would you say that your decision-making is always a deliberate rational process? (Alternatives - Evaluation - Choice)

(4.2.2.) In what degree do you let intuitive influence factors impact your decision making? How important are gut feelings in DMP in crisis situations, do you rely on them? Can you give an example?

(4.2.3.) Do you find it difficult to think clearly when you have to decide something in a hurry? How do you balance the conflict of quality and speed? Can you give an example? Do you still feel in control of things?

(4.3.) Are there any differences in your decision-making before, during and after a crisis? Do you have any example to give us?

(4.4.) Have you ever been confronted with different types of crises? What were they? Has your decision-making changed according to these different types?

**AI on DMP in Crisis situations**

(4.1.) The world becomes more and more technological and automatized. If you think about decision-making processes in crisis situations…

(4.1.1.) Do you already have any experiences with AI in this context? If yes, would you like to exemplify them?

(4.1.2.) What benefits of implementing AI on DMP in crisis management do you see?

(4.1.3.) What threats about applying AI on DMP in uncertain environments can you imagine?

(4.2.) Lastly, what do you think is your major competitive advantage compared to AI, what do you think is AI’s biggest advantage compared to you?

5. Back-up questions

(5.1.) To what extent followers’ acceptance is important regarding decisions taken under crisis situations? How should decision-makers make people adhere to their decisions?

(5.1.1) How the use of AI for decision-maker will influence the followers’ adhesion to decisions taken?

(5.1.1.1.) Will decisions be considered better thanks to AI, so better acceptance?

(5.1.1.2.) Or will they see the use of AI as a lack of competence?

(5.2.) How do you value trust in crisis situations, towards decisions, competence, organizations? Between the different layers of an organization?

(5.2.1.) How the use of AI will impact trust between decision-makers and followers?

(5.2.2.) How people involved in a crisis can trust an agent they sometimes don’t understand? How will it impact crisis management?
APPENDIX 3: INTERVIEW GUIDE FOR AI EXPERTS

How artificial intelligence can affect decision-making processes in crisis management?

Goal of the study:
(1) find out what is really important in DMP in crisis management
(2) find out which experiences/fears crisis managers have with new technologies
(3) how AI’s technology can replace important features of DMP in a foreseeable period of time

1. Self-introduction

Hello, we are Pia and Guillaume and we are currently conducting a study for our master thesis in management at Umea School of Business & Economics in Sweden. First of all, we want to thank you for your participation in our work and for the time you will give us by answering some questions. We would like to mention that our study has received an ethical approval from our university, which implies that your participation is fully voluntary, and you can stop the interview at any moment without giving any reason. We will make sure that your personal data will be kept confidentially. There is no right or wrong answers. For some practical and ethical reasons, we would like to record the interview: would you agree if we do so? Finally, when answering our questions, don’t hesitate to give us examples, it will allow us to better understand your point.

2. General Information about Interviewee

(2.1.) What is your current occupation and how is it related to Artificial Intelligence?
(2.2.) Have you been working in the field of Artificial Intelligence before? If yes, on how many years/companies/positions can you draw your experiences upon?
(2.3.) Why are you interested in the field of Artificial Intelligence? Is there any particular case that you would share with us?

3. Background information about the other topic

Short introduction of the concept of crisis management

4. Questions about Artificial Intelligence

Al on DMP

(4.1.) To what extent would you say is AI already used for DMP within organizations?
(4.2.) We divided DMP into rationality and intuition. Decisions based on rationality are thereby defined as direct results of comprehensive information gathering and processing, meaning that decisions are made after following a sequence of logical steps, i.e. identifying alternatives, evaluation, choice. On the other hand, an intuitive DMP is based on human’s subconscious, where especially perceptions, heuristics, experiences and emotions become important.

(4.2.1.) When it comes to the rational part of DMP, our research showed, that supervised and unsupervised machine learning is able to decide faster and more
comprehensive than humans can. Do you see any other advantages or disadvantages of applying supervised and unsupervised learning to DMP within organizations?

(4.2.2.) When it comes to the intuitive part of DMP, reinforcement learning is probably the only possibility to cover human decision-making skills: do you think the development of reinforcement learning will be able to replace human decision-making skills in a foreseeable period of time? If yes, which time horizon do you think is realistic until the technology will be implemented and used by organizations?

(4.2.3.) Considering that human opinion is necessary under crisis situations to take the biggest decisions, which type of AI do you think is the most appropriate to use during these events?

AI on DMP in Crisis situations

(4.4.) Under crisis situations, DMP need to balance both, comprehensiveness and speed. Which benefits of implementing AI on DMP in crisis situations do you see in the foreseeable future?

(4.5.) Do you see any threats about applying AI on DMP in uncertain environments and which are they?

(4.6.) Under crisis situations, decision makers are influenced by several intuitive human features to take their decisions (like perception, heuristics, emotions, experience, leadership...): How do you think AI can cover these features?

(4.7.) Do you think this technology will lead to better DMP under crisis situations? Why/Why not?

(4.8.) Lastly, under crisis situations, what do you think is humans’ major competitive advantage compared to AI, and what do you think is AI’s biggest advantage compared to humans?

5. Back-up questions

(5.1.) To what extent followers’ acceptance is important regarding decisions taken under crisis situations? How should decision-makers make people adhere to their decisions?

(5.1.1) How the use of AI for decision-maker will influence the followers’ adhesion to decisions taken?

(5.1.1.1) Will decisions be considered better thanks to AI, so better acceptance?

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(5.2.) How do you value trust in crisis situations, towards decisions, competence, organizations? Between the different layers of an organization?

(5.2.1) How the use of AI will impact trust between decision-makers and followers?

(5.2.2) How people involved in a crisis can trust an agent they sometimes don’t understand? How will it impact crisis management?
# Appendix 4: Interview Information

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