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Information Processing at the Digital Age Journal

Organization of Knowledge and Advanced Technologies (OCTA)

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Chapter 6: MAMCTA Multi-Agent Model for Counter Terrorism Actions

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Abstract

Today, the world is affected by a new concept of war called terrorism. As plans to face conventional enemies have become unusual against terrorism, there are a necessity for innovative concepts and technologies. In order to support units, we aim to upgrade the capability of leaders structuring their choices. In this paper, we offer a multi-agent architecture for the planning of actions against terrorist attacks. It is distinguished by decisive policy responses and methodical procedures for managing the situation, as well as by the flexibility to adapt a contingency scenario. We describe the relationship between actors during a terrorist attack in order to establish the best possible distribution of units to neutralize the enemy.

Keywords: Multi-agent, terrorism, Attacks, Model, Modern war, Irregular war, Organization.

1 Introduction

Peacetime planning aids in the anticipation of potential crises and ensures a rapid choice during actions. Even the counter-terrorism planning is based on real-time events, leaders could inspire their course of action from peacetime plans. The decision-making process can be considerably accelerated if the conditions of the terrorist attack cross with the assumptions in a previously developed plan. The principal hypotheses of the plan should be subject to certain rules such as: types operations, forms of manoeuvre, tactical objectives and the organisation of operational forces. Then, operations must be scheduled in time, space, and objective. The degree of risk that commanders are prepared to take in resources' allocation should be taken into account (Army 2005).

There are many forms of plans that vary in scope, as well as in complexity and duration of execution.

Strategic plans cover the overall conduct of a war. Operational plans support the organization of military operations to reach a strategic objective within a fixed time and space. The deployment of units in operations and their interaction with each other and with the enemy, present the role of tactical plans. It is about pushing forces to use their full potential. These plans are fused together to handle a coherent approach of the warfare conduction. Not only poor planning could lead to military failure, but it may due to the inadequate execution or a major gaffe, as well as a lack of skill or talent. It may also be due to the absence of modern military technology. Modern warfare has become more complex and necessitates high-technology.

As a result, many countries are striving to develop new warfare technologies to create more developed weapons, to form units by simulating a virtually real-world environment and even to assist the commander in reaching better operational decisions.

In fact, with the increasing costs of major weapon systems, simulation that deals with combat is the most effective way to reduce the army's budget; it is identified as one of the key factors in ensuring that military objectives are reached with the lowest costs by saving material damages and reducing the requirement for expensive prototypes and real dangerous trials. Simulation aides in bridging the time-induced tension between political and military exigencies in the control of war actions. As a result, simulation helps achieve political-military congruence by reducing the time required for the deployment of forces. Congruence will be enhanced by helping those in positions of authority to gather sufficient information in order to make an effective decision on evolving combat situations. In fact, all of the above reasons combined with the huge number of actors and the need to make decisions in a short period of time with a changing situation push us to use multi-agent simulation.

The simulation of modern warfare is very distinct from the simulation of traditional warfare, this difference is a matter of concept of warfare. On the one hand, modern warfare is generally based on asymmetric warfare described as combat between two opponents with difference in strength at the outset (Galula 1964). On the other hand, traditional warfare is a Blitzkrieg, an inter-state war marked by its proportional clarity.

While approaches of asymmetric warfare generally seek to have a major impact on modelling, it frequently uses innovative and non-traditional tactics, weapons or technologies, and can touch on all levels of warfare (strategy, operations and tactics) within the full range of military operations.

There are three types of asymmetric warfare: guerrilla warfare, war of independence and terrorism. Guerrilla warfare consists of a number of militant groups, behaving as a military unit and thereby taking the name of paramilitary forces or combatants. Guerrilla tactics involve: ambush, sabotage, "hit and run" methods. They tend to shun open battles and focus on stalking and weakening the enemy's power, driving them out of the battle. Fighters are trained as soldiers. Under a commander, they wear a distinctive uniform to show their affiliation. The aim of guerrillas consists usually in exercising pressure on the government to control or dominate the territory and the population and they only target military units.

The War of Independence is a civil war against colonial domination or foreign occupation. It is defined as “any armed conflict that involves military action internal to the metropole, the active participation of the national government, and effective resistance by both sides” (Small and Singer 1982).

With reference to the CIA definition, the term “Terrorism” “means premeditated politically motivated violence perpetrated against non-combatant targets by subnational groups or clandestine agents”.

Although terrorism has sharply risen in recent decades almost everywhere in the world, it is still relatively rarely simulated. The efforts of the Tunisian army in some counter-terrorism missions have been marked by a lack of any meaningful results.

The failure to identify and understand the enemy and to generate an appropriate plan leads to a mismatch between forces, capabilities, missions and objectives. We therefore work to build a coherent organizational response plan that is guided by strategic, operational and tactical laws.

To accommodate the large number of components and information, with the multidimensional needs, we propose a multi-agent model that describes the role of each actor. This model is able to support the decision markers with an integrated tool.

The paper is structured as follows: The next section addresses various simulations associated with counter insurgency situations and provides a brief description of simulations context, tools, and used procedures to model and schedule operations in different point of view. In the following two sections, we present our Multi-Agent Model for Counter Terrorism Actions called MAMCTA. Subsequently, we show the difference between MAMCTA and the model that inspired us in this work. We finish with a discussion and a conclusion.

2 Background

In the past, the modelling of armed conflict (AC) was more straightforward because AC was classic, very broad and involved heavily armed state actors. This motivated the development of large-scale force models. However, these kinds of conflicts are always possible and demand known modelling. Modern armed conflicts, such as terrorism, are small-scale, include non-state actors and need revolutionary models. The analysis of the impacts of this type of asymmetric warfare and the analysis of response measures are of major interest to government and first responders.

Basic estimates and probabilistic considerations could be employed to establish acceptable expectations and outcomes, while examining patterns of violence in terrorist incidents, categorizing attacks and their urgency levels, and determining a common pattern for the size distribution and timing of these events. To deal with the large number of parameters, many analytical models grasp only some key dimensions of armed conflict; a group of differential equations is offered by Lanchester to outline the dynamics of force-on-force engagements (Lanchester 1916). These equations have been developed and in wide use by the US military during the last 60 years. Even the Lanchester models offer a convincing physical description of combat military behaviour; they have been mainly criticised in the academic literature for the discrepancy between decisions made in armed conflict and decisions made by simulation and the difficulty of verifying them (Lepingwell 1987) (Scheffran et al. 2012).

Some models dealing with terrorist strikes are built on the notion of coalescence and fragmentation of either insurgents or terrorist organizations. To model counter-terrorism operations, we need to emphasize two main challenges: Detection and Protection.

In order to identify and intercept terrorist plots, it is essential to develop robust intelligence gathering and enhance the analysis of terrorist behaviour. The progress made in data mining and the application of specially adapted techniques will allow for a better distribution of resources and improved processes during the analysis phase. As State-controlled forces are often much larger and better equipped and trained than non-State

actors. Non-state actors hide among the civilian population and use simple but deadly weapons to prevent detection and targeting by state forces. Civilians thus emerge as a key element in modelling irregular warfare, which is not the case in Legacy (AC) models. The civilians are a source of information for government forces and in some cases for terrorists, and a target for terrorist strikes (Kress 2012). Legacy models should be used to address homeland security needs on issues such as the evolution of national security infrastructures, border control and currency circuits. A large civil violence model simulates two scenarios (Epstein 2002). The first deals with rebellion against central authority, while the second deals with ethnic violence between two groups.

This model is extensively cited, it employs simple reactive agents and pertinent variables to model the performance of the agents. To overcome insurgents, it would have to cut off their recruitment routes by reducing the increase in population support to those insurgents. These assumptions are the outcomes of Iruba's agent-based guerrilla model; it also shows that high mobility and the use of guerrilla tactics against government forces could make a huge impact (Doran 2005) .

A different simple model of population growth was developed by Johnson and Madin (Berman et al. 2009) to examine the dynamics of an insurgent population. They concentrate on the factors that determine the success and failure of an insurgency by valuing the size of the insurgent population, recruitment rates, and the carrying capacity of the population (Johnson 2009).

Recently, inspired by Deitchman's (Deitchman 1964) classic guerrilla model and the Lanchester model (Lanchester 1916), Kress and Szechtman's (Kress and Szechtman 2009) research deals with the dynamics of insurgencies.

Some models have been expanded as a model of attrition reinforcement demonstrate that an insurgency cannot be totally erased by force; at best, it can be kept at a stable level, which can only be remedied by political circumstances (Scheffran et al. 2012).

Based on the hierarchical structure popularized by Wooldridge and Jennings (Wooldridge et al. 1995), Cil suggests a multi-agent military unit combat simulation model (MABSIM) that aids small unit commanders in the decision-making process in stressful environments (Cil 2009). Limitations of the complex adaptive systems present the backbone of his work. Cil uses a multi-agent architecture motivated by the complexity of validating these systems and the lack of an explicit and verifiable interaction model by combining agents and their interactions in a single model (Yang, Abbass, and Sarker 2005). From his point of view, hybrid agent architecture presents a clearer solution to bridge the gap between cognitive and reactive agent systems. Cognitive systems for a large number of agents quickly become unanalysable even if they still capable for reasoning about actions, whereas reactive systems adapt better to scale. However, it is difficult to understand or authenticate their unreasonable behaviour (Gowlett 2011) (Cil 2009).

The multi-agent asymmetric combat simulation architecture ACOMSIM (Cil and Mala 2010) is an expanding model from MABSIM that aims to fulfil the needs of future multi-dimensional warfare. It models the behaviour of small units in asymmetric warfare.

ACOMSIM has derived its hierarchical structure from the Wooldridge and Jennings structure, where the first layer focuses on planning and decision making, while the second layer examines the relationships between different agents and the environment. The first layer of ACOMSIM includes seven cognitive agents and six associated databases. See Table 1.

Table 1. Agents and databases in ACOMSIM model

Cognitive agent	**database**
Mission analysis agent	Intelligence database
Mission time scheduling agent	Environment database
Enemy situation analyzing agent	Terrain database
Own situation analyzing agent	Enemy tactics, techniques and procedure database
Terrain analysis agent	Tactics, techniques and procedures database
Logistic agent	Logistic Database
Action Generating Agent	

The second layer uses MANA (Map Aware Non-Uniform Automata), which interprets warfare as a complex adaptive system to test high-level plans and generate feedback to the commander. MANA was designed as a scenario exploration model to solve a wide range of problems.

Another example highlights the economics of counter-insurgency: Berman's (Berman 2011) armed revolts are an alternate explanation for asymmetric warfare where civil strife and social disorder turn into armed conflict. Unlike conventional models of blitzkrieg warfare, the issue of asymmetric warfare is not related to the initial size of the forces; it relies solely on the number of people supporting each side and the combat effectiveness of both government and rebel forces. This model reveals the conditions of a stalemate and emphasises the critical effect of external intervention as a factor in the tilting of power.

The research publications and the few analytical and dynamic simulations developed are initial tentative efforts to model irregular warfare. The major challenge is to combine attrition models, political, social and behavioural science, and economic theory into a single unified model. The dissemination of ideas that show how people change their attitudes and capture the influence of private and public policy preferences on the decisions of their governments is of great interest for social modelling. Social networks are key to emphasizing the connectivity of the population, its dynamics and its impact on the actions of state and non-state actors. For this reason, models that describe social and behavioural components must incorporate social networks. Makowsky and Rubin (Makowsky and Rubin 2013) proposed an agent-based model that tests the impact of government and social network technology on the falsification of preferences and their racial effect on how revolutions are conducted. They argue that the topology of these self-organized networks changes over time, and the effect of regimes and insurgents' actions on these dynamics, are an important factor in explaining changes in popular behaviour.

Finally, the agent based model of Pechenkina and Bennett (Pechenkina and Bennett 2017) provides a hybrid combination of minimizing collateral damage and insuring the implication of the counterinsurgency military strategy. They suppose that we have a better chance to defeat an insurgency if we use a combination of the military action that targets insurgents without harming civilians.

Our model expands ACOMSIM model to cover the three levels of the warfare (strategic, operational, and tactic). We choose this model (Cil and Mala 2010) as a starting point for the reason that it allows for a full range of military strategies from tactic viewpoint.

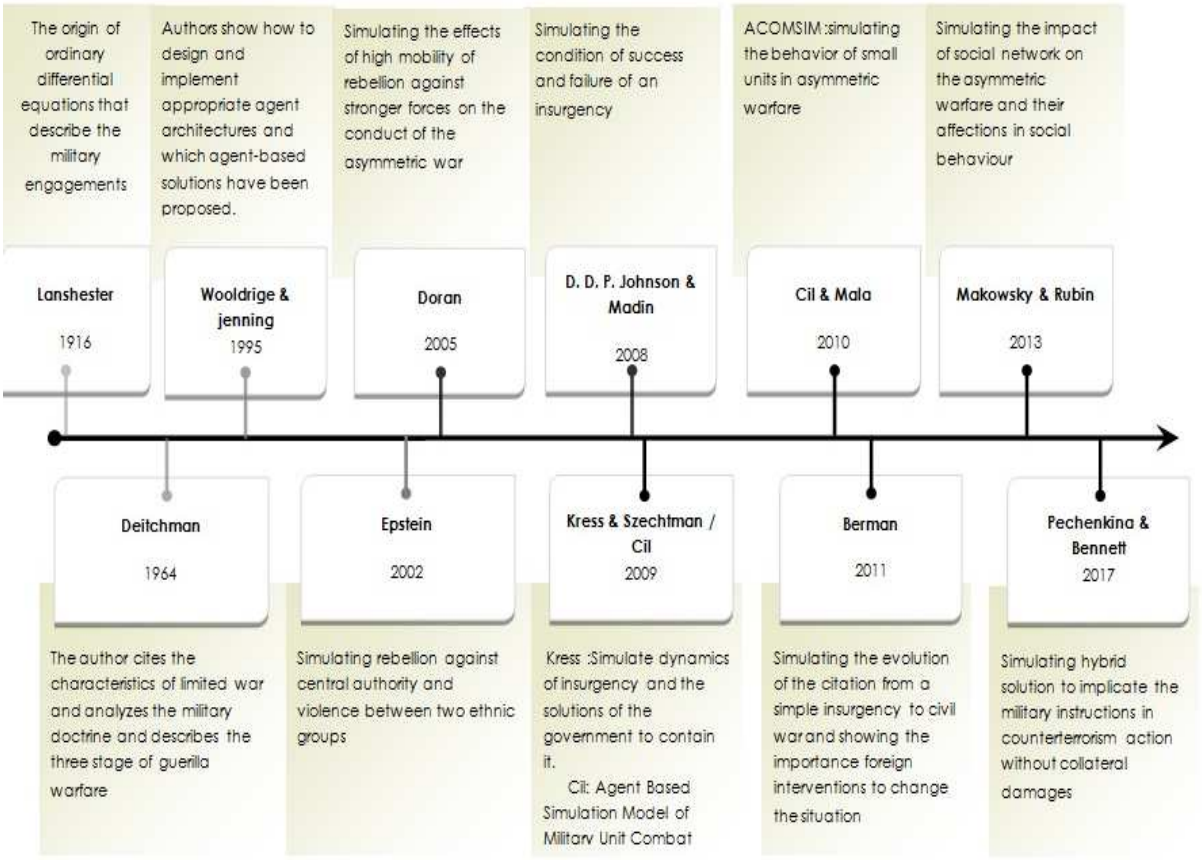


Figure 1.Related works on asymmetric warfare simulation (O. Kebir et Al. 2020)

3 MAMCTA model

3.1 Model architecture

In order to defeat armed insurgent groups, governments include military, paramilitary, political, psychological and civic aspects in their plans. Usually, a non-state opponent aimed at the overthrow or territorial change of incumbent state sponsors those groups. In this paper, we consider that our model assumes two core types of aspects. The first focus on the decision-making and organizational aspect of the organizational plan by analysing changing behavioural decisions. Due to the sensitivity of time during counter terrorism mission, it has become essential to make the right choice, dissect problems and minimize losses. These choices should not be arbitrary or subject to the caprices of commanders, but follow a pre-established organizational plan.

The relationship between the different actors is hierarchical with a limited degree of freedom in execution, leaders must have more autonomy and flexibility in the management of their human resources in a way that allows them to create a better working atmosphere. Otherwise, they should not miss the predefined objectives and not go beyond the limits of the task at hand by being accountable for the use of their authority.

One of the most appropriate ways to deal with situation-specific ordering procedures is the multi-agent system. It is necessary to manage interactions between different people or organizations with conflicting objectives and proprietary information. In the first layer, we do not focus on human resource management in our model. Instead, we model the relationships between the different actors. As a result, a well-designed small-scale program would increase the government's effectiveness in managing terrorist attacks compared to a poorly designed program.

The second layer takes care of human resources management and the deployment of the different actors. In military terms, this layer represents the tactical phase of the operation, which deals with the manner in which units are deployed during the battle. Although there is no tactical checklist for asymmetric warfare, since each application is unique and has never used a particular combination of options before each situation, we may have to incorporate new options to counter asymmetry (Ancker and Burke 2003).

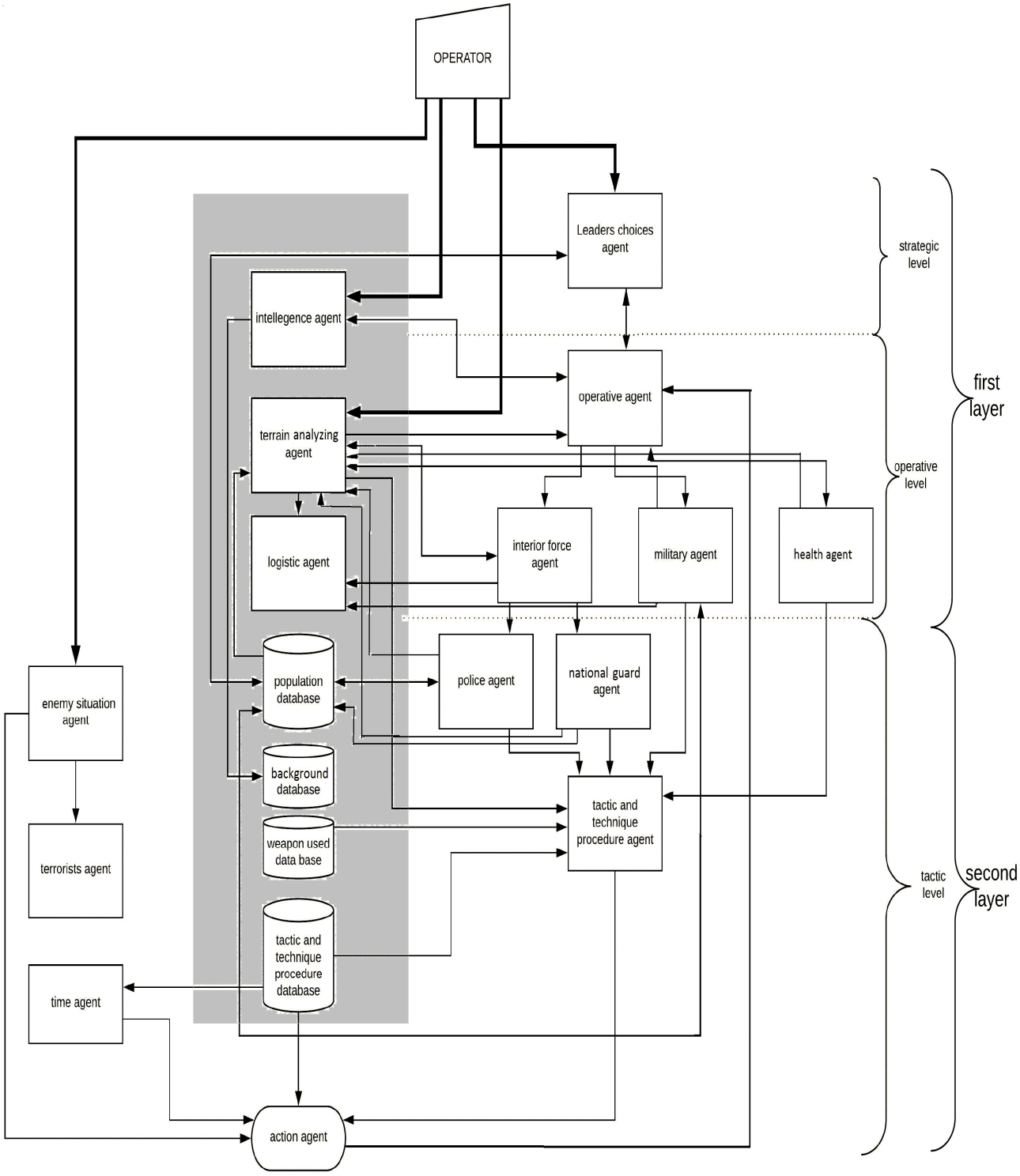


Figure 2**.** MAMCTA Model (O. Kebir et Al. 2020)

3.2 Model mechanism

We model the organization's plan to counter a terrorist attack. The leader’s choice agent will analyse, with reference to the political situation, the seriousness of the attack based on the time of the attack, its location and the size of the population. At the strategic level, these parameters have more effect than others. The resulting decisions can support confidence in the functioning and authority of the state.

In our case, leader choice agent sends to the operative agent the time proposed for this mission. Concurrently, a predefined plan will be executed in the tactical level; location of the attack is the only input parameter that runs this tactical process. This plan organized a crack anti-terrorist reaction unit. This unit could reportedly assemble and deploy anywhere in the field without strategic or operational directives.

The operative agent classifies the level of emergency of the terrorist attack after providing a global vision on the situation in operational areas. Activities of this agent match results obtained from the intelligence agent and terrain analysing agent to establish a conventional vocabulary about the emergency level of the attack to achieve the tactical objectives, initiating actions, and applying resources to bring about and sustain potent countering actions.

In our case, the leader choice agent provides the time proposed for this mission to the operative agent. Concurrently, a predefined plan will be executed at the tactical level. The attack location is the only input parameter that runs this tactical process. This pre-organized anti-terrorist reaction could be useful anywhere without strategic or operational directives.

The operative agent classifies the level of emergency of the terrorist attack in a predefined scale. Results obtained from the intelligence agent and the terrain analyzing agent are matched by the operative agent to give birth to a new classification of the level of threat on a conventional scale that preserves the confidentiality of information.

The military, health and interior force agents receive the level of emergency. Then, each one of them choose the optimal number of interveners for the mission.
The military agent support tactic and technique procedure agent with soldiers which reinforces the number sent in predefined plan. Moreover, the same process will be carried out by the health agent to contribute to the exact number of ambulances needed.

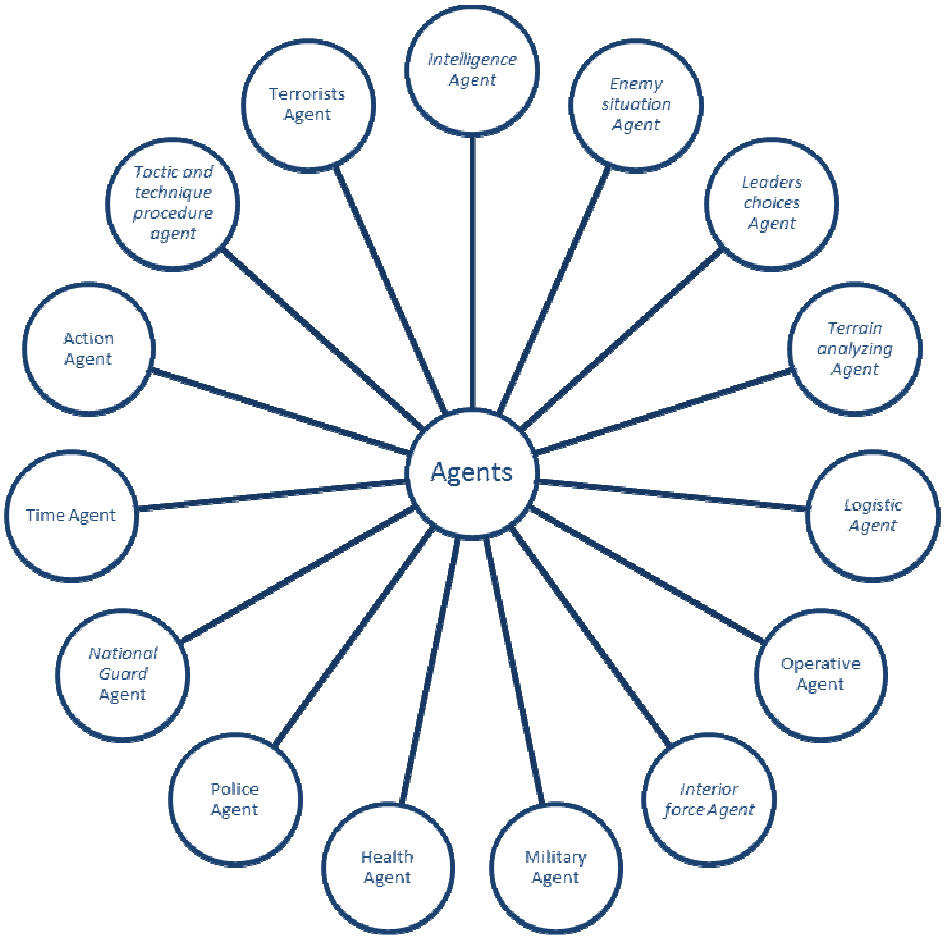
In urban areas, anti-terrorist actions are governed by a territorial distribution of authorities between the different governmental organizations. In order to choose the principal agent to neutralize terrorists, the interior force agent is based on territorial distribution from the terrain analyzing agent. Besides, it points out the headcount needed from each base concerned by the intervention. Those data will be sent to the police agent and the National Guard agent to create a tempo-dispatching of intervenient based on the number of soldiers available in the bases.

The tactic and technique procedure agent receives the results from the police, National Guard, health and military agents. Then, it handles the actors' dispatching in the field. To obtain the optimal results and limit the terrorists' ability, this agent makes the tactic choices.

The action agent takes in charge the tactic engagements based on tactic and techniques database: The latter one may neutralize the terrorists with minimum losses. The action agent combines the terrorist’s deployment plan provided by the enemy situation agent and the soldiers' geographical positioning from the technique and tactic procedure agent.

3.3 The description of the set of Agents and databases

Our proposal handles different agents and databases as presented in Figures 3 and 4 respectively. We describe thereafter every one separately.



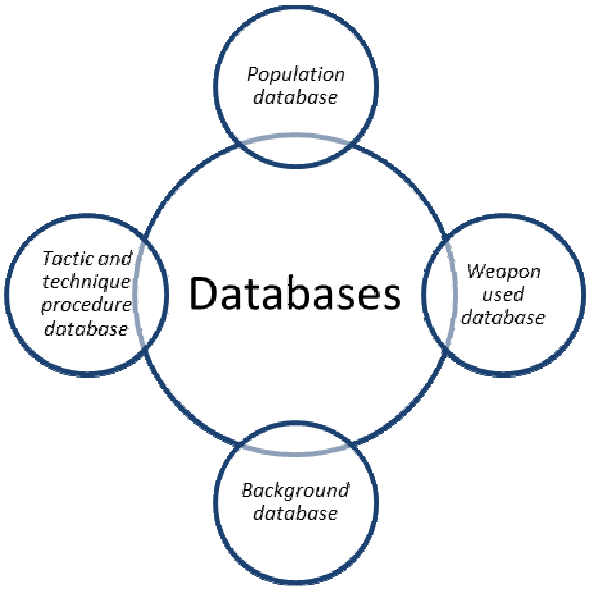


Figure 3: The set of agents within our proposed model

Figure 5: The set of databases within our proposed model

Agents description:

To describe the fifteen used agents in our model, we use Table 2 to show their definitions and objectives:

Table 2: Agents' descriptions

Agent's id	**Agent's Name**	**Description**
Agent 1	*Intelligence Agent*	*Intelligence agent* offers prediction the victims's number, at the end of the attack, based on the *(1)* size of victims in the real time, the *(2)* size of terrorists, the *(3)* Location of the attack, the *(4)* Time of the attack, and the (5) Population in the place of attack. I presents the operative agent with a classification of terrorists based on the subsequent information such as: Type of attack: isolated or organized (operator) Possible weapons used in the attack (operator) Backgrounds of terrorists and religion affiliation (background database)
Agent 2	*Enemy situation Agent*	*The enemy situation agent* is responsible on terrorists' distribution on the field during the action. It takes in charge the tactical phase of the enemy. These tactic reactions depend on the type and professionalism of terrorists (intelligence agent) and the access way to the battle field (terrain analyzing agent).
Agent 3	*Leaders choices Agent*	*Leaders choices agent* presents the strategic level of the mission, where decisions of the politic leaders are based on *(1)* Time (it influences the number of civilian in the targeted place), *(2)* Location (it influences the media and strategic decisions), (3) Population's size in the place of the attack. In our model, this agent is used to define the duration of the

		mission based on the three mentioned factors *(1), (2), and (3).*
Agent 4	*Terrain analysis Agent*	*Terrain Analysis Agent* receives data from the operator to offer information about: The best access manner from and to the attack's location (time-based): decisional and organizational aspect. Key points in the field, Concept of the operation, Avenues of approach, obstacles: management of the human resources in operational aspect. This agent uses UTM WGS84 as a system of location. It indicates the position following a coordinate system using: A geodesic system: WGS84 (World Geodetic System 1984): global system used for GPS and especially GPS maps IGN. A projection (grid): Universal Transverse Mercator projection (UTM) is used for GPS. The coordinates resulted from the UTM projections are based on a decimal system.
Agent 5	*Logistic Agent*	The aim of this agent is to proof the logistic level of units and support them with necessary logistic items at the right time and place. Therefore, it has to make decisions about the necessary logistic level based on: Duration of the mission Number of solders needed for the mission After that, it has to choose the right course of actions for the execution using information about location from terrain analyzing agent. Outputs are sent to the military agent and interior forces agent. Logistic agent is not always used because generally missions against terrorist attack are limited in time and they don't need a lot of logistic sources.

Agent 6	*Operative agent*	Its goal consists in identifying a categorization of the level of emergency creating a common language to produce a system that allows for quick reaction between all intervene actors. The classification is based on *(1)* Terrorists' Classification, *(2)* Estimation of the evolution of the number of victims, *(3)* Period of the attack, and *(4)* Location. This categorization provides a summary of attacks' information to the *military agent*, *health agent*, and *interior forces agent*.
Agent 7	*Interior force Agent*	*The interior force agent*'s responsibility consists in assigning the duties of the Ministry of the Interior according to the attack's geographic location and the time factor through the strategy of the action plan. Based on the classification of the attack this agent will specify the *(1)* needed number of police man and national guard, and the *(2)* bases concerned about intervention.
Agent 8	*Military agent*	In urban areas, military interventions are well identified, and he goal of solders is generally to help interior forces to neutralize the enemies. *Military agent* receives the classification of the attack from the *operative agent* then designates the number of solders needed from every base. This agent gives the better distribution and planning of solders during the mission in accordance with *terrain analyzing agent* and *population database*.
Agent 9	*Health agent*	In case of terrorist attack, hospitals must be capable to receive injured persons for medical and surgical treatments. Consequently, medical resources optimization is fundamental to save human lifes. This agent takes care of the distributions of available ambulance in time, as well as the capacity of hospital close to the place of the attack. Actually, this agent may present a wide topic of research, so we are limited to the management of ambulance and their distribution in the area of the terrorist acts.
Agent 10	*Police agent*	In cooperation with *terrain analyzing agent*, this agent aim to provide police forces sufficient as requested by *interior force agent* from the police force available in the bases concerned with the intervention. The available number of policemen will be extracted from the *population database*.

Agent 11	*National Guard agent*	National Guard agent owns the reel number of National Guard forces available in bases. It works to provide the number needed by *interior force agent.*
Agent 12	*Time agent*	Time have an extremely significant consideration for reducing the gap between military and political needs. In fact, it intervenes in every process, even directly when the operation of the agent depends on time, or indirectly by affecting other agents having a direct relation with it. *Time agent* is responsible of the organization of time. It assigns the time needed for every step-in tactic level of the model. This agent replicates the Mission time scheduling agent that has been used in ACOMSIM model.[1]
Agent 13	*Action agent*	*Action agent* completes the plan and formats in the input form of the simulation, since it presents the last agent and he summarizing agent in the first layer. The final output should cover optimal decisions about *(1)* Planned execution (tactic plan), *(2)* Concept of operation, *(3)* Loss probability.
Agent 14	*Tactic and technique procedure agent*	This agent employs forces in the theater of operations to obtain an advantage over the enemy that will bend him in the entire operation and that is by attain strategic goals through the design, organization, and conduct of different actors. This agent controls the dispatching of forces on the field based on inputs from *terrain analyzing agent, military agent, National Guard agent,* and *health agent.*
Agent 15	*Tactic and technique procedure agent*	*Tactic and technique procedure agent* is dedicated to employ forces in the theater of operations to obtain an advantage over the enemy that will bend him in the entire operation and that's by attain strategic objectives through the design, organization, and conduct of different actors. This agent controls the dispatch of forces to the field on the basis of data provided by the *terrain analyzing agent, military agent, National Guard agent,* and *health agent.*

Agent 16	*Terrorists agent*	*Terrorists' agent* focuses upon the notion of action and reaction in the behavior of terrorists' behavior and models what terrorists do in combat with referring to instructions from *enemy situation agent*.

Databases description:

To describe the three used databases in our model, we use Table 3 to show their definitions and objectives:

Table 3: Databases' descriptions

Database's id	**Database's Name**	**Description**
Database 1	*Population database*	Its purpose is to offer *(1)* the estimation about the size of population present in the attack region, and *(2)* the key places usually have massive crowd of people such as stations, big commercial centers, museums. *Population database* indicates how many people in this place at that time. Besides, it gives police agent and guard national agent the information regarding available number of solders in bases and police offices.
Database 2	*Weapon used database*	It offer information about the useful characteristics of the weapons of the enemy such as the *(1) Type*, the *(2) Rang*, and the *(3) Energy of the explosives.* Those information have a high significance during the tactical phase, where they allow us to distinguish between dangerous areas and the rang targeted by terrorists.
Database 3	*Background database*	Its purpose consists in perceiving the reaction of the enemy. Inputs are the type of the terrorist group that they belong to, as well as their religion attributes from a database and the proposed goal of this attack furnished from the Intelligence Agent. This database yield to help to classify

		terrorists.
Database 4	*Tactic and technique procedure database*	The aim of this database is to generate military rules of combat based on the field commander's tactics.

4 Comparative study between ACOMSIM and MAMCTA models

In this section, we perform a comparative study with one among the most known models, called ACOMSIM, in order to highlight the innovation of MAMCTA model through focusing on various concepts related to the two models. The ACOMSIM is a model along with a simulation about the asymmetric warfare. It analyzes Cil and Mala's model which focuses on guerilla warfare, where, in our new MAMCTA model, we target to model terrorism. The different types of warfare are shown within diagram in Figure 4.

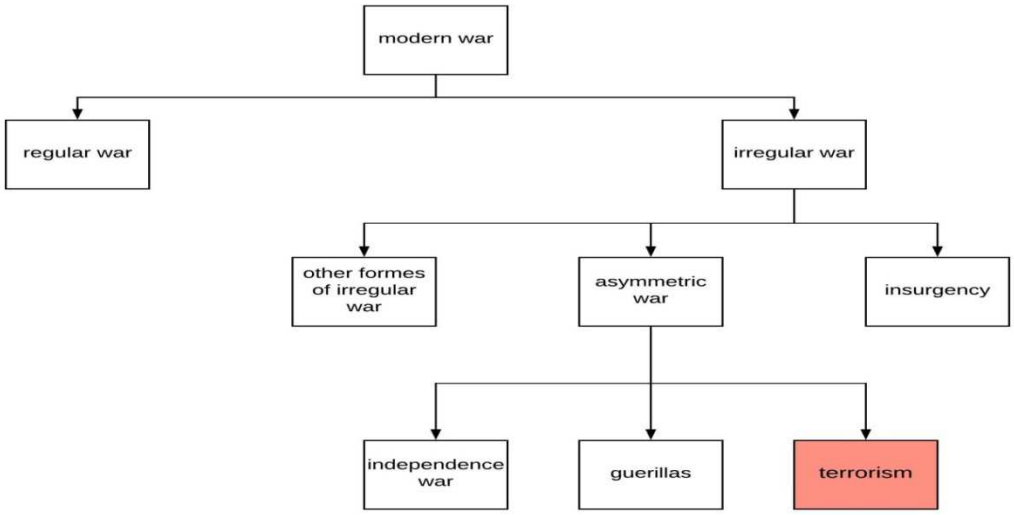


Figure 4. Types of warfare

4.1 Civilian and collateral damage

Generally, civilians present the actor present in the terrorist attacks. Hence, they may be injured victims or hostages and even terrorists' Human shields. They are beneficial in the case when they offer to armed forces useful information and collaborate with them. However, they become obstructions if they betray their countries by supporting terrorists. In our model, we try to give meaning of civilians' presence in the battle field creating an estimation of victims present in the attack.

4.2 Terrorists and attacks levels' classification

In fact, the ACOMSIM model regards planned combat between two armed groups. It does not take in charge the specificity of terrorists and their backgrounds if they are trained somewhere or if they belong previously to another terrorist group. Those information are so significant since terrorists don't behave as a traditional army. Consequently, we may figure out a terrorist's classification to reveal their threat level.

4.3 Level of warfare modeled

There are three levels that characterize a warfare which are the strategic, the operational and the tactic levels. First, the strategic level aims to define and support national policy and relates directly to the outcome of a war or other conflict as a whole. Second, the operational level of war lies between both of the strategic and tactical levels. Third, the lowest level is the tactical level where individual battles and engagements are fought. From the one hand, the ACOMSIM model, structured the mission from only one viewpoint, which is treating the tactical level. It simulates the management of the combat from the local level, assigned to tactic units, where activities and engagements are planned and executed to achieve military goals. From the other hand, our MAMCTA model treats the three levels of the warfare. These differences are further shown in Table 4.

Table 4. Difference between the two models

		ACOMSIM	**MAMCTA**
Type of the asymmetric warfare		Guerilla warfare	Terrorism
Civilian and collateral damage		Not modeled	modeled
Classification of terrorists and attacks levels		no	yes
Level of warfare modeled	**strategic**	no	yes
	operative	no	yes
	tactic	yes	yes

5 Conclusion and future work

The MAMCTA for *Multi-Agent Model for Counter Terrorism Actions* model enables leaders at all levels to understand the higher intent of the mission in order to adapt and use the directives to begin their own order planning and development process. The purpose of designing the MAMCTA model is to be able to lead the planning of specific actions and tasks to produce the right combination of effects in terms of time, terrain and objective.

We list the contributions of some researchers in the domain. Although we could find conceptual solutions in the literature, it is still difficult to agree on the efficacy of their counter-terrorism process. In our new bi-layers MAMCTA model, the relation between actors is described in terms of their interaction's analyses and tasks' affectation. The architecture of intervenes' connection, modelled as organization or person, arises

from the plan hierarchical vertical interactions' structure. Hence, our model's architecture offers a new and simplified reasoning architecture which obeys to the principle military planning concepts in the reality. It facilitates synchronization between commanders and their subordinate unit to link the concept of strategic level of operations with their operational design structure. To do, we made use to the ACOMSIM architecture as a starting point to analyze the relation between the different actors in the tactic level. Finally, we have shown that our new MAMCTA model provides a complementary tool for the different level of course of actions.

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