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Geo-informatics in fighting crime and in strengthening public security

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1 INTRODUCTION

The police personnel must have the ability to examine information, therefore an information system showing data in the most visual and practical form becomes beneficent. Displaying information using the stated formula of the map (situation map/plan) not only confers naturalness but also opens the premises for correlation between the followed entities/events and the particularities of the area where they happen (the zone considered together with its anthropical and natural elements, in the modelling closest to reality).

The police activity often assumes cartographic organization, and transposing this geo-spatial management through the digital approach brings many advantages, as informatization has proved it in many domains.

The modern approach in fighting criminality is based on geo-information applications (GIS) able to:

- represent the digital map of the jurisdictional zone, with its specific interest topological elements;
- monitor the geo-spatial details of the crime-suspected persons;
- reveal the problematic areas (occurrences/risks);
- administrate information concerning the criminal events from the circumscription; etc.

Here are several geo-spatial locating methods applicable in the IT assistance designed for police activities and for managing the situations which endanger the public safety:

by interactive dialog – the localization vocally provided by the caller for the event/incident is recognized by the dispatcher operator and transposed in a position on the digital map;

- automatically – the information system knows the address from where the burglary sensor signals and cryptographically shows it on the screen;
- the automated theft-protection system of a vehicle queries its GPS receiver (which calculates its position by astronomical “triangulation”, respectively by a spherical back-intersection using signals from specialized satellites) and transmits the actual position to the security service where it is connected (LBS, AVL);
- the telephony operator can provide, in case of high necessity, the phone location (by certain LBS techniques – such as cell-ID, CGI+TA, TDOA or E-OTD – the mobile phone can be geo-located in the area of the cellular antenna network – fig.);
- radio-labeled entities (people, mobile equipments) can be dynamically located in the perimeter of a Wi-Fi site (e.g. a campus/building having a 802.11g standard wire-less network).

By intensely exploiting the visual capabilities of cartographic symbolization – respectively by using the powerful GIS symbology: thousands of colours, patterns/fills, transparency, contouring, point-formed of filar symbols, qualitatively and quantitatively parametrized symbols; and also any combinations of these to get typological differentiated representations of the crime events/incidents – the comparisons and relations are in the first place automatically and even involuntarily made by the human eyes/brain.

A long-term benefit of the police activity informatization consists in the potential of integrating video-conferencing and training technologies too.

2 DISPATCHING AND POLICE CALLING CENTERS

If an IT-assisted phone calling centre is implemented at the police unit (inspectorate, division, section), its cartographic subsystem can display a variety of information about the community (geo-spatially referenced), helping the dispatching-operators to process the incoming calls. In this manner the centre's personnel – usually constituting the first contact point between the public/community and the police – possess additional modern and trustful tools. By using the GIS application the operators locate the address of the caller and can transmit information (retrieved on the spot from the police's database) towards an emergency service from the caller’s neighbourhood.

Sometimes the calls toward police do not require an immediate answer, and the resolving of the signalled problem is done by a local entity around the caller (proximity officer, collaborating institutions – such as those for social services, or other organizations), and for such situations the dispatcher can efficiently disseminate comprehensive information (possibly assembled as a portal built on the community map and published through Internet).

Graph 1: A geo-information assisted dispatcher

The cartographically displayed data reveal (especially when they are aggregated in strategical approaches) spatial points with high frequency of crime/troubling events (hot-spots), in such a way that, for subsequent incidents in these zones, a higher priority or a particular resolving modality can be assigned from the beginning.

From another point of view, the implementation of such geo-information systems in police departments causes the personnel's motivation to rise, as a consequence of technological and professional new challenges and also because of the feeling of being part of a modern organism which benefits from the interest of the administration.

Here are some generic requirements for the control application in a emergencies communication centre (using Computer-Aided Dispatch solutions):

- easy implementation and robustness/reliability;
- user-accessibility in the exploitation stage (reduced learning and assimilation efforts);
- reliability and robust functionality for dispatching operations (in accordance with exploiting specifications, and eventually including advanced facilities, such as identifying the closest intervention unit to the signaled/detected event);
- specific functions for treating those situations which jeopardize public security;
- mobile communication with the on-site personnel and assistance for them (field support/guidance);
- interoperability with subordinated/related police departments and with other agencies involvable in the management of critical situations (ambulance, fire-fighters, emergency situation inspectorates, civil defence, local/national administration, telephony operators, etc);
- reports generation abilities (including dynamic field data capturing) and the possibility of integrating them with the records management system.

Beside the GIS features, such a system could also include AVL functions (Automatic Vehicle Locator, subscribed under LBS), hereby guaranteeing that the closest police/emergency unit/team will be directed towards the event/incident location, therefore minimizing the intervention time.

The mobile communication component of the dispatching system provides the field personnel with real-time geo-spatial integrated details about the actual incident and situation operating/treating details, and even warning notes. In this way the mobile agent will be better informed before reaching the respective scene, which enhances his own security as well as public safety. A side-effect of this informatics and automated cartography approach consists in freeing the dispatcher operator from the position of unique contact point between the incident and the intervention team, respectively in reducing human errors.

In addition, here we can also count the capabilities of accessing important information from locally, nationally or internationally constituted criminal databases.

3 GEO-INFORMATICALLY ASSISTED BRIEFINGS

There are GIS applications available designed for the facile, suggestive and comprehensive presentation of specific information meeting the needs of police workers in the frame of instruction meetings – daily briefings (on shifts), or briefings expressly caused by criminal emergencies – on the PC screen or by video-projection. The work instructions contain data/details about wanted criminals and about criminal incidents, about suspected people and about recidives, about criminal tendencies and the law enforcement pro-active measures, about risk areas, about the people under investigation, paroled people, etc. In the same information system aerial photography, satellite images, video-camera recordings can be engaged too.

The cartographic vision over the controlled area helps police to study diverse scenarios regarding field-forces distribution (a regular repartition or an issue/event conditioned repartition): the sector can be divided depending on streets, blocks, area units, or upon other controlled criteria. In certain circumstances one can even evaluate the success probability for each scenario (using analyses of previous recorded cases, or quality criteria particularly developed).

Graph 2: A geo-spatial briefing with IT support

The informatics-assisted geo-spatial approach can be useful also in the case of instructing and repartitioning police forces in order to ensure control of the large mass events (shows, concerts, sport events, political/social meetings, officials' visits, etc), or even for effective crowd coordination. And in case of a bad incident occurrence in the frame of such events, the police intervention/action will be more coherent and more rapid due to the knowledge of the geo-spatial situation and due to the possibility of real-time gearing of specific resources and IT&C means.

Such a computer program becomes useful in the tactical organization of raids too (such as the raids focused on illicit-drugs): on the one hand the responsible officers find the building location (and identify the owner/administrator of that building), take into account what is around it, observe accessing ways, measure the distances; on the other hand they establish the detailed mode of approaching/operating – the necessary number of policemen, their positions, communication means and passwords, actions timing/synchronization, police-specific means and equipment transportation, etc.

Also briefing schemes and contents prefigurable scenarios conceiving become possible, which will later require only small updating/adjustments before effective exploitation. In addition, the informatics component of work instructions can be archived (stored on a local disk or in storage devices available through the computer network), and this fact makes it easy to monitor the development of cases and to share this information toward different sections of the police or justice. Storing the operative briefings also facilitates self-briefing when/where this is suitable/appropriate.

It is worth mentioning the fact that digital instructions also means less paper and bureaucracy, respectively more time for the concrete activity of police/justice.

4 CRISIS MANAGEMENT

The GIS can constitute an intelligent software for assistance in special situations or crisis management, ensuring the enhancement of response time and of the treatment efficiency in case of security incidents appearing. Here one can also take into account the pro-active approach, including by developing tactical/strategical plans for restoring normality after a crisis. Such solutions can be used in identifying the geo-spatial and temporal conjunctures which favor crime and security incidents too, in this manner being helpful from the perspective of the pre-established treating/approaching/acting methodologies as well.

The system has the ability to function with direct links to live monitoring points from circumscriptions and from institutional, civil and industrial facilities (such as airports, large warehouses, store networks, fuel distribution networks, etc). By the unified integration of the GIS data/functions with security sensors, with surveillance video-cameras, with telecommunication means (for text, voice, video) and with human interaction, such IT security management applications can deploy in a (quasi-)automated fashion answering procedures/algorithms beforehand prepared (action scenarios involving situation signalling to the implicable persons/institutions, transmitting instructions/information for treating the situation, alarming the intervention forces/troupes, triggering some auto-protecting devices, additional recordings over the event, etc).

We can surely say about such information systems that they also have valences toward the «decision support» (hence a generic management perspective), but their principal effect consists in reducing the reacting and restoring times, and in the mitigation of destruction and losses (therefore, in rising tactical efficiency). In addition, by the technical modernity (as they are advanced digital solutions) and by acting coherence (disciplining intervention/restoring efforts due to the fact that all those involved precisely know what they have to do) – both assumed by implementing/exploiting a such a protection solution – the customers' investitions in security are protected (for institutions, enterprises, communities).

It is more and more often proposed that the Computer Aided Dispatch (CAD) systems from the emergency services (unified-112, Police, Ambulance, Fire-station, Civilian defence, Emergency Situation Inspectorates, Environment guards, etc) should have a cartographical user-interface, so that the dispatching operators should possess an interactive map which can display the location of the emergency calls, and which can also represent the geo-spatial and topological situation of the respective area. This opens the collaboration possibility between these services too (and other administrative institutions affected or involvable in emergency situations).

The cooperation between the police, ambulance, fire-brigade and local administration for united interventions can be achieved with the help of a system conceived to have "multi-agency" capabilities, which should enable the deployment of an unified answer in case of a specific event. Such a system can comprise: CAD (computer aided dispatching having geo-spatial representation and cartographic interaction), records management, telecommunication equipments, mobile data devices, on-site automated reporting. And among its basic requirements we can recognize: robustness (reliability, assimilability); flexibility (adaptability to particular and evolving requirements, connectivity with other information applications, scalability to support operation raising and changing, interconnectivity potential with other circumscriptions/jurisdictions).

From an anthropological perspective we will remark, about such geo-information systems, the linkage attribute between human resources and technological ones.

5 CRIMINALISTICS ANALYSIS

A software solution for crime prevention and treatment and for public safety control helps with a more efficient marking of the hot-spots from the covered area.

The digital cartography approach also assists at preventing crimes through the fact that it can clearly identify crime behaviour (revealing it in different hypostases by specific geo-spatial analysis). Here are several concrete modalities in which such a GIS can assist crime fighting:

» fast and easy creation of trustworthy maps showing events and crime phenomena;

» revealing patterns of criminal actions (hiring and/or disclosing criminal's moving paths, recidivism, the temporal crime coordinate, geo-spatial high-risk spots/zones, etc);

» revealing criminal tendencies in the controlled area (by geo-temporal statistical analysis);

» reducing the time needed for identifying and comparing similar crimes; etc.

The hot-spot points on a digital map – possibly distributed across the urban infrastructure configuration (aligned along an avenue; surrounding a commercial building; along a fuel pipe) or upon the nature geography (on the river banks, at a forest-edge, on a mountain crest) – have two functions:

- become a means of interaction (an interface element) whose pointing by the user (with the mouse cursor) will bring on the screen information about the represented crime events;
- provide a visualization of the geo-spatial crime pattern, revealing tendencies and risk spots/areas.

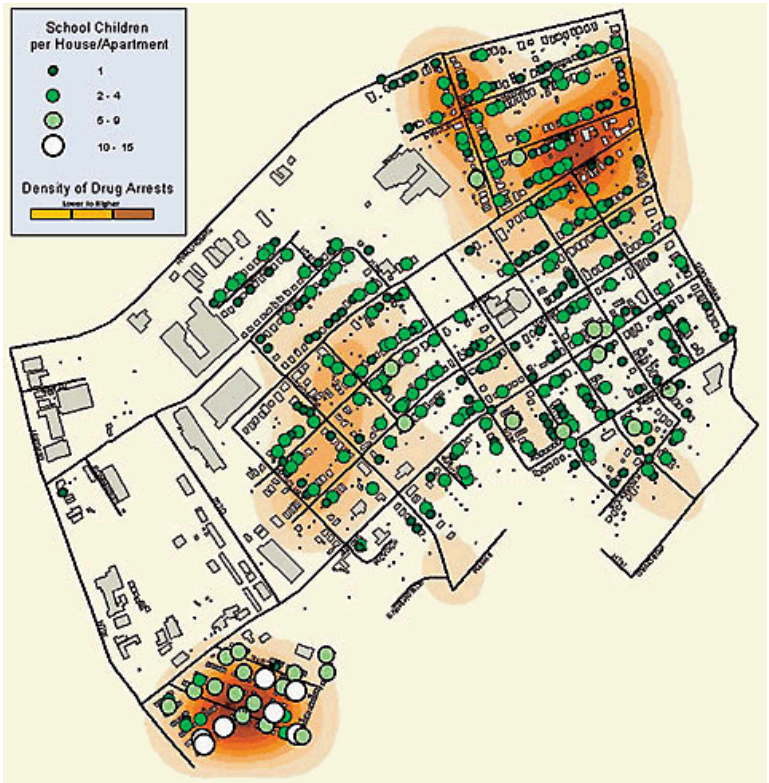
We can observe that most of this criminalistics information is also available to policemen, investigators and detectives by classical means, but scattered and in recipients not easy to consult (files, analogical archives, work annotations, people's memory, etc). Due to the geo-informatics approach the information is fast to retrieve and from a unique query/source, and they can be aggregated in diverse forms and analyzed from different perspectives.

The crimes repeated by the same person usually have something in common, a pattern, a habitude, which – after being revealed with the IT assistance – helps the police to catch the criminal and/or to prevent the crime.

Another benefit of geo-information systems consists in the support of the police officers to draw/establish the route by which the criminal can escape from the crime scene/area – as off-line scenarios (foresights), or as a result of real-time monitoring of that zone – with a positive effect over the on-line assistance given to the teams/patrols from the respective area as well.

Because from a graphical perspective the GIS has a «metric» character, the investigators also benefit from the «precision» attribute when they analyse the moves done in criminal acts:

- representing/revealing the real/probable routes/paths/ways of entering/departing in/from the crime scene;
- exact measurements of the distances between buildings and facilities;
- evaluation of the time lapses needed, inclusively for the transport of the means involved in crime; etc.



Graph 3: Spatial relations between children density and drug arrests

Hot spot statistics, generated by time-conditioned GIS analyses, can say when/where there are chances the next event to happen, therefore the police can prevent its deployment/occurrence. Such studies also help with the proficient placement of surveillance devices (establishing the most suitable locations and orientations).

Policemen know from their expertise that the crime phenomenon is not constituted of isolated facts, that there are causal or human relations between apparently distinct events, therefore when a crime is solved indices can appear to resolve other cases. On the one hand, by visually approaching the incidents – this being the substance of geo-science – specialists can see connections that otherwise are not visible/obvious. On the other hand, the informational unification (assumed/caused by implementation of such an information system) allows the current user to access results from the works of other investigators too.

From the police/judiciary management point of view, the assimilation of such information solution can lead to the restructuring and optimization of the police resources.

The cartographic representation of the criminal incidence can be also oriented outside police department: toward public (for warning, with an educational purpose, or for public services transparency reasons); toward mass-media (press communication; (extra)ordinary reports); towards other interested/involved organizations (law-courts, prosecutors and attorney offices, educational institutions, social services, human rights institutions, European integration, etc); or channelled to population categories who constitute with predilection the targets for crimes (such as store owners).

Revealing criminal patterns (disclosed through analysing the criminal incidents previously recorded in police databases) helps to solve related events as well as the prevention of future/probable events and the mitigation of their effects (by deploying proper measures).

The analyses revealing criminal patterns are most suitable for large urban communities. The geo-information system of a city will centrally record/store huge collection of informational entities (hundreds, thousands, millions):

critical calls (signaling events before start, in their course, or after);

complaints (signaling risk situations and potential ones);

arresting the persons as flagrant offenders or as being pursuit by police as crime suspects; etc.

Accessing these data, along with their analysing abilities by the geo-information system, helps the investigators to more easily identify the criminal situations and to answer/respond more efficiently to the crime events. The police personal can visualize the city circumscription-after-circumscription (the cartographic representation can theoretically comprise anyhow// GIS sources, allowing a better identification of geo-spatial relationships and particularities of the town) and even has the ability to follow the suspects towards the location where they are supposed to run and hide.

A «parametrical» interrogation example: “how many X type events have occurred in the Y days (salary days for the Z company) in an area surrounding for W meters the V barroom?”.

But more complex analyses (gearing more data types, aggregated from diverse perspectives, or even using spatial/alpha-numerical subqueries) can reveal more subtle aspects (such as the time-shifted causality relations) or other indirect linkages between the geo-spatial configuration, phenomena, events and other conjunctures.

The strategical cartography capabilities provide criminalists with a intuitive manner of analysing and visualizing the crimes classified on diverse criteria (among which the geo-spatial component/attribute forms a valuable connector). The result of statistical analyses help the executive personnel to take measures for stopping the peaks of crime activities intensifying before becoming worrying tendencies. At operative levels, the same analysing functionalities become useful for criminal locating and arresting. Moreover, benefiting from «information-telecommunication» integration and from performant organization, police professionals can access/receive such information by fast means (radio-telephony, e-mail, instant-messengers) before they arrive at the crime scene.

Also, geo-information can be used for analysing (and preventing) car crashes, because by studying the automobile accidents from an area (city, county) one can rapidly reveal and understand the causes/circumstances which provoked/favoured them. In this application the abilities of replaying certain analyses under different parametrization will be extremely useful – studying “what if” scenarios involving

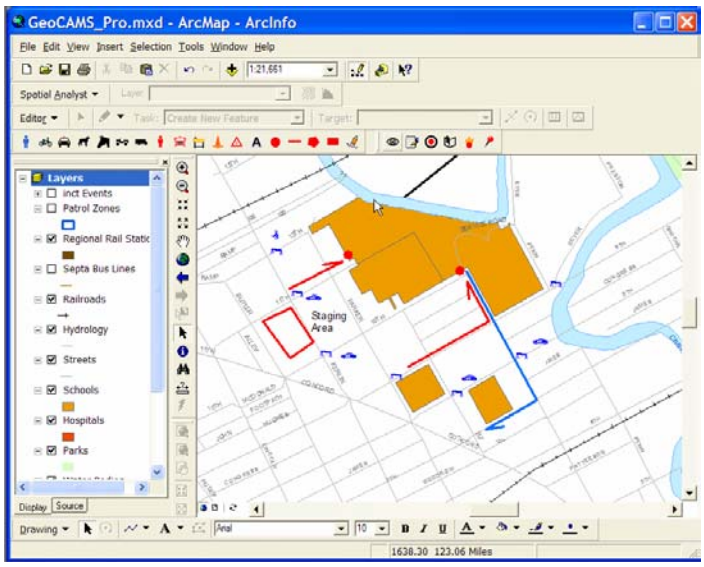
variation regarding speeds, weather conditions, traffic crowdedness, visibility, road surface type and state, vehicle power, tire type/state, etc – so unchaining an intelligence which can help with reducing collisions causality. Likewise, the operative activity of auto-traffic police can benefit from such optimizations, mainly by assuring/consolidating those locations and those day/week times which have revealed a high accident rate (by supplementing with agents and specific materials). Also in this direction, when accidents occurrence thematic maps can be published, the GIS becomes a public education vector.

6 CRIMINALITY CONTROL AND MINIMIZATION

A criminality control specialized GIS helps to visualize and analyse the information describying the incidents from an area. The geo-spatial distribution of crimes, explicitly showed and followed, allow the police specialists to maximally exploit their resources to satisfy/cover the rising request of critical services. This information system can include functions such as following:

- recording the call (made by phone or by other means) and the incipient information;
- triggering the treating/intervention procedures (signaling, alarming, informing, instructing, assisting, monitoring);
- automatically getting the cartography of the incident;
- tools/capabilities for dynamical interrogation (including spatial query engaging the GIS native entities in any combination) and for exploiting the digital model;
- computing and revealing the hot spots on the jurisdictional map;
- the ability of selecting the incidents on temporal criteria (hour, day, date, season, year);
- printing maps (in composition profiled on concrete necessities, in any constituency and at any scale) for disconnected (off-line) analysis or for field on-line assistance;
- fast generation of complete reports (predefined and/or definable, and with a dynamic link to the database, providing trust and assuring the data freshness);
- query defining, editing and re-deploying;
- searching criminal incidents by diverse criteria (classification, type, data, hour, frequency, address/location, road crossing neighborhood, user-defined buffer, people's names for criminals, suspects, victims, court sentences, etc);
- statistically revealed risk and crime tendencies/patterns;
- suggestive and comprehensive graphical interface (including MapTips able to be revealed when the mouse cursor stays over the criminalistics significative graphical entities); etc.

By collaboration between city-halls and the police, schools can benefit from IT systems assisted protection for crisis management. These can integrate call centres and departments/services from the police, and also video monitoring from key locations in the protected site/buildings and automated check of specific automated security sensors (intruder alert for limited access areas, proximity sensors, fire/smoke detectors, etc), maps, geo-spatial imagery (off-line or eventually on-line satellite images), site/building designing plans, intervention/evacuation plans, inside/outside photographic pictures, etc. Such systems can provide critical information to the police, to fire-stations, and to other protection/emergency services, thus helping the fast formation/development of the best and fastest answers for emergency situations, and reducing the negative effects (concerning human's integrity and freedom, and property damage).



Graph 4: The digital plan of a school situation intervention

Naturally, for applying such strategies and implementation at a local/national level several administrative incentives or even legislative initiatives are needed, but – before all – people must understand the potential of these solutions. Likewise, such programmes can be extended to other public vital facilities (courts, communitarian buildings, cleaning-water plants, etc).

In the same geo-security domain one should also subscribe certain IT&C solutions designed for goods planning, relocation and protection (from equipments to facilities and buildings). Thus, the inventory administration for geographic spread resources enterprises/institutions can be completed with functions for security, relocating planning, real-time tracking for displacement, etc. Such applications can be also exploited through the Internet, LAN, or VPN, and can interact with other organizational information systems (human operated of automatically functioning).

In those countries where the juridical/penal organization uses probation (conditioned/paroled release, or with suspended punishment) there are systems which dynamically follow the location of potential criminals, simultaneously offering advanced capabilities for continuous communication, which helps with fighting and preventing crime repetition by conditionally released people or by recidivists. By combining cell telephony with the GIS technology, and based on a monitoring centre assisted by a specialized GIS, such a system automatically tracks the real-time location of potential criminals, facilitating, when needed, the communication between the parolee officer and the conditionally released person. In fact, the monitoring centre operator (geo-informatically assisted and having telecommunication means) becomes “the eyes and ears” of the responsible officer, therefore he can be charged with more cases/tasks.

In such an approach, the person who is considered as having crime potential is forced/constrained to wear at the ankle a small device which – by using the GPS based dynamic geo-locating technology – transmits the location information to the monitoring centre operators (or toward the responsible officer), with a meters precision. When connected to the GIS application, the officer can identify and ad-hoc establish particular restrictions for access (to prevent the monitored person from going into certain locations, such as parks, schools, etc), therefore the monitoring systems operators and/or the parolee officer will receive a signal/warning when/if the conditioned person is approaching/entering an excluded area. Moreover, by the bi-directional communication feature of this system, these professionals can initiate a dialogue with the respective person to warn him and to guide him, thus preventing the breaking of the parolee release. The system can somehow de-tension the difficult relation between the released person and the parolee officer. Likewise, the monitored person understands that is dealing with a hard to trick system. And, on the other hand, the officer effectively gets:

» an additional and substantial continuous help in his mission;

» the possibility to monitor the assigned persons from any location (anywhere an Internet connection exists, including wireless);

» uninterruptible and reliable functionality (sometimes in any global location, due to the combination of satellite tracking, the unlimited cartography ability of the geo-informatics system, and to the continuous communication through mobile telecom).

In the advanced countries there are well-tuned geo-information applications designed for assisting the kidnapping cases (having effective features for spatial locating and for public/citizens cooperation).

7 GEO-INFORMATIC APPLICATION IMPLEMENTATION

Surveying and maintaining public security/safety (by the police inspectorates/sections) can benefit from criminalistics cartography informatics/digital tools to access, display and analyse data concerning crime incidents (previous incidents, current/deploying or in course of solving). This information usually includes: the crime location, suspect address, geo-spatial marks, police jurisdiction, and other geo-referenced data. The GIS application will be able to deploy the following analysis types:

- studying the crime events occurrences;
- analyses of the automobile accidents (events in auto traffic);
- cartographically revealing crime high risk points (hot spots);
- assistance for judicial/penal instrumentation/prosecution of the cases;
- logistic support (organization, resources, planning, tactics);
- tracking the recorded persons known for the sexual abuses;
- neighbourhood surveillance;
- cartographic assistance at releasing the arresting/holding orders, searching orders, property sequestration orders, etc.

An essential component in such systems consists in the locating intelligence, which can have a critical role in analysing important information and to ensuring citizens' security. In addition, the cartographic data flux/flow involved in police dispatching can be integrated with dynamic updates through GPS in order to supply the exact location of an incident, or of the field team who will also receive routing/orientation instructions.

From a somehow synthetic perspective one can identify the following stages/phases for implementing and starting a GIS solution for criminality control:

1.identifying and defining the base requirements and the particular/local specifications;

2.database configuration and collecting the data describing previous police activity (especially from unsolved cases or from recidivist potential cases);

3.installing the application and populating/linking with existing data (and configuring the "server");

4.testing and/or teaching the information system administrator (the IT&C responsible person from the section/department/institution);

5.installing the "client" application and instructing the final users.

Generally, such software applications run on/under the Microsoft Windows operating systems, and are built on/in GIS renowned environments/platforms (however we also notice the existence of several solutions designed for alternative operating systems, such as Unix, Linux, MacOS, and the increasing tendency toward the "open-source" domain). Usually these applications use data files in GIS known formats and accept to read/import data in many standard formats (GIS/CAD, database, tables, spreadsheet, text, raster/bitmap images, satellite images, multi-media documents, complex documents, etc).

8 AT THE END

By engaging complex geo-spatial analysis functions, and by absorbing information from partners (from administration or from civil society), the GIS application becomes an essential element in the fight against crime and anti-social behaviour.

On most of the GIS renowned platforms commercial solutions are already developed, designed for criminality control and for law enforcement through the geo-spatial approach, and they can be the object of

studies, bids, contracts and public acquisitions (of those administrations which want to control crime in their circumscription – local, county, zonal, national, regional, continental).

9 AFTER THE END

From the point of view considered by this theme of "geo-informatics in law enforcement and crime mitigation", beyound the plan (because sometime «to plan is not enough») there are also other things/issues needed (or just recommended for the succes of the project), such as:

- education for the clerks (public servants);
- involvement of a larger/broader number of persons/people;
- shifting atitudes (regarding the subject or concerning the methods);
- obtaining public acceptance;
- political/strategical incentives to leverage the plans;
- synergy developing.

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