APPLICATION POSSIBILITIES OF ADVANCED ANALYSIS OF PUBLIC DATA SOURCES IN THE FIGHT AGAINST CHILD MALTREATMENT

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Abstract

The article presents a new look on the use of existing data sources in combination with modern methods applied for the purpose of data processing. Modern ICT technologies allow efficient operations run against large amounts of data. Creation of dedicated analytical models allows to efficiently combat and prevent crimes, e.g. crimes committed against people, including prevention of child abuse. The article also characterized a possibility of using long existing data registers and records to prevent such crimes. The use of modern IT methods and tools in combination with the well-defined and integrated data sources (not only national) allows to increase detectability of certain types of crimes, without the necessity of involving additional efforts or means. Furthermore, the examples given may be applicable in many places worldwide even though they refer to data sources in specific countries. Such approach is also justified due to the fact that modern criminal activities are of international character.

Key words: administrative data; interagency administrative data research; data analysis; prevention of crime; public registers; data sources; methodological approaches to Big Data

Introduction

The development of ICT methods and technologies in combination with the evolution of data models open up entirely new possibilities of their application in different areas of human activities. In particular, the above refers to such areas, which have been neglected so far, for example, due to large amounts of data or absence of analytical tools that could be used for efficient and effective data processing and analysis.

Child abuse may be analyzed from many different perspectives. It is often associated with domestic violence. The research on child abuse shows that violence against children in the family has significant impact on children, their future physical, emotional and social wellness, which often leads to inequality and marginalization. Awareness of the long-term implications should contribute to better identification of persons at risk and development of efficient intervention methods to protect children against violence (PAAVILAINEN et al., 2014). The latest research shows that children and adolescents experience all sorts of domestic violence, i.e. physical, emotional and sexual abuse. They are also victims of neglect and violence between parents. The same instances of child abuse occur in many countries in Europe and worldwide. All the supporting activities, which help to improve efficiency of combating such pathology, should be taken into consideration.

This study aims at giving a broader view of the causes of child abuse. The analysis and impact of the environment, in which such mistreatment takes place, constitute an important complementing element in the process of its prevention. In particular, the above refers to the use of available data sources, which have not been used before for the purpose of such analysis. Their use could bring positive, yet not direct, results in combating the aforementioned crimes.

It needs to be highlighted that this article does not directly tackle the issues of child abuse. Its purpose is to show the possibilities of using existing data sources to prevent such pathology. Due to the fact that the data analysis is often performed by persons who are not professional technicians or IT specialists, the article provides information on the types of registers and records as well as modern methods and techniques of data exploration that could be used – without going too much into technical details. It was also stated that the proposed solutions do not have to entail additional costs, since the discussed data sources already exist and are relatively easily available.

The interest in using substantial data sources (Data Warehouse, Big Data, noSQL Databases, Stream Database) largely boils down to the processing of more and more amounts of data and larger data volumes. The same refers to social networks. The emergence of still more innovative data (information) solutions usually triggers the emergence of still more innovative ICT tools designed to handle such solutions.

It appears that "old", well-structured databases for processing data in a traditional manner have been forgotten. The article includes an attempt to look at these "old" data sources by using the cutting-edge IT techniques and methods for their analysis (Figure 1). The presented approach refers to the so-called public registers and records, which cover the whole population of a given country (region) or include data about all objects of a certain type (e.g. real estate records). Their basic feature is that they have been kept for several dozen years (even if initially maintained in a traditional, i.e. paper, manner), they are public (which not always means that everybody can use them) and usually managed by government or public administration units (KIEDROWICZ, STANIK, 2015). A clear-cut advantage of such traditional databases is also the fact that the data contained therein are in most cases "cleaned" and complete.

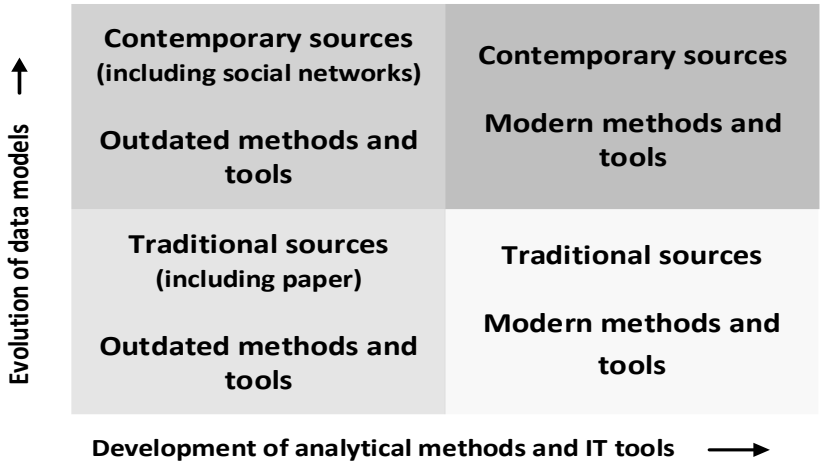

Fig. 1. Application of IT methods and tools in comparison with the development of data models.
Source: Own study.

The presented examples mainly refer to Polish registers and records, but it was shown that they may also be applied in other non-European countries. The examples include issues connected with the analysis of seemingly unrelated registers and records as well as links between different persons (entities), with special emphasis on a possibility of using the results to combat and detect illegal activities, including analyses of crimes against people (also including child abuse).

In the next part hereof, the registers, which are not "naturally" associated with a possibility of their application for combating and preventing child abuse (either primary prevention or prevention of recurrence) were described. Usually, these are the registers that need to be kept due to other provisions of law. It is especially important and significant, as child abuse is not prosecuted in all countries worldwide. The proposed solutions allow organizations dealing with combating such crimes to carry out their activities, without any risk of breaching the law.

Public records

The use of databases based on a relational (traditional) data model in combination with SQL (Structure Query Language) and advanced analytical and static methods allows to produce very good results. The currently used public registers and records are usually constructed in such a manner. The traditional databases mainly include databases based on a relational model as well as network and hierarchical models (which are less often used nowadays). Attention should be given to the terminology connected with the databases based on the network model, which are commonly referred to as the "network databases" as opposed to network databases that are currently developed (sometimes, for the purpose of differentiation, they are called "graph databases").

The analysis of data sources in public registers and records covers such registers and records that exist in similar form in different countries. The similarity mainly refers to the IT content of such registers and records relating to the same characteristics of the same type of objects. The aforesaid objects may constitute persons, legal entities or things. While considering the current technology, it may be assumed that the problem of non-compliance of the types or scopes of the predefined attributes may be relatively easily solved. The choice of certain registers and records is also determined by the analysis of legal grounds that define the manner of creation and later processing of data in such registers and records. Data integration is one of the most important aspects of the described approach (Figure 2). Two basic types of integration may be distinguished:

- Horizontal – appropriate identification and combination of data about the same real object (person, entity, thing), which occurs in the same registers in different companies, regions or even countries (e.g. registers of people, entities, vehicles, etc.). Registers in different countries may be called differently and cover different scopes of characteristics of certain objects, but the basic scope of interest remains the same.
- Vertical – appropriate identification and combination of data about the object (person, entity, thing) in different registers and records in a given country.

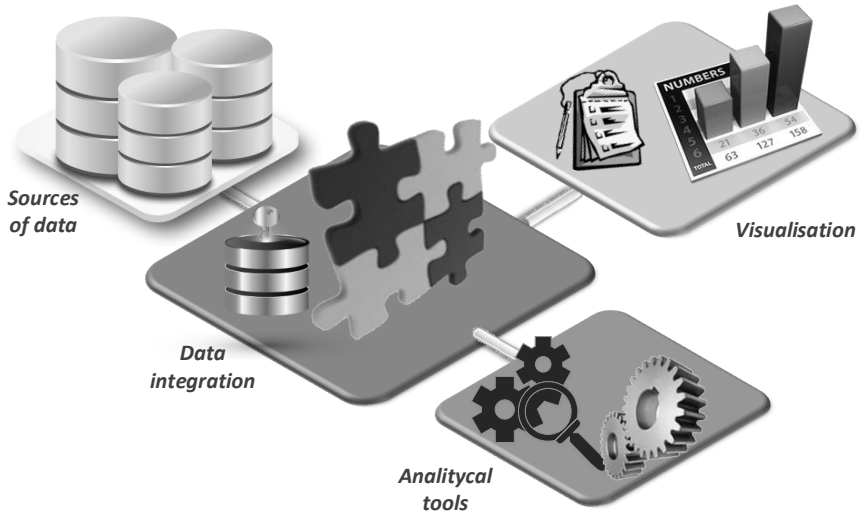

Fig. 2. Diagram of use of of existing data sources.
Source: Own study.

Vertical or horizontal integration allows more efficient application of the methods and analytical tools. On the other hand, simultaneous application of both vertical and horizontal integration (i.e. mixed or hybrid integration) constitutes a more advanced method of integration. While considering the analytical tools used to combat and prevent crimes, it is only the hybrid integration that offers a possibility of their complete application (KIEDROWICZ, 2014a; KIEDROWICZ, 2012).

The horizontal integration may be illustrated on the basis of records and registers in different European countries. Such registers and records may refer to the following objects: natural persons, entities (legal, economic), taxpayers, real estates, vehicles (Table 1). For instance: Poland (PO), Czech Republic (CZ), France (FR), Spain (SP), The Netherlands (NE), Lithuania (LI), Germany (GE), Hungary (HU), The United Kingdom (UK), Italy (IT).

Table 1. Comparison of registers and records in selected countries.

Registers, Records, Data Resources	PO	CZ	FR	SP	NE	LI	GE	UK	IT
Population register	x	x	x	x	x	x	x	n/a	x
Records of entrepreneurs, businesses	x	x	x	x	x	x	x	x	x
Tax records	x	x	x	x	x	x	x	n/a	x
Real estate register (cadaster)	x	x	x	x	x	x	x	x	x
Vehicle register	x	x	x	x	x	x	x	n/a	x

n/a – data not available

Source: Own study based on (CIEŚLIK et al., 2015).

The vertical integration may be illustrated by different registers and records kept by the public administration of a given country. Table 2 shows certain characteristics (attributes) of the objects, which exist in the majority or all of the discussed registers or records.

Additionally, the column "Notes" in Table 2 pertains to the possibility of applying the so-called mixed integration. Special attention was paid to the processing of the same (semantically) data in different registers and countries. The aforesaid approach allows to use appropriate data and information resulting therefrom to combat all sorts of social pathology.

Table 2. List of selected attributes in selected registers.

Attribute	Population register	Business register	Property register	Notes
Personal ID number	x	x	x	Different structure in different countries
Name	x	x	x	Used for identification of persons in contacts between EU Member States
Birth name	x	x		
Home address	x	x	x	
Date of birth	x	x		
Place of birth	x	x		
Documents	x	x	x	ID documents (passport, ID_card)
Date of death	x			
Citizenship	x			
Company name		x	x	Additionally, the company's logo
Company address		x	x	Addresses of all subsidiaries and branches
Place of business activity		x		List of countries, regions
Management Board	x	x		For all members of the Management Board
Shares	x	x		Amount of shares, list of shareholders
Real estate identifier			x	Different in different countries
Designation of real estate			x	Geographic coordinates, maps
Type of real estate			x	Lands, buildings, premises
Purpose of real estate			x	Apartment, trade, services, etc.
Value of real estate			x	Carrying and/or market value
Owner of real estate	x	x	x	Volume of shares, representation
Additional real estate details			x	Depending on the type, the following: area, dimensions, type of development
Mortgage	x	x	x	Type and amount of mortgage, entity in whose favor the mortgage was registered

Source: Own study based on (CIEŚLIK et al., 2015).

Such approach to the use of resources existing in various registers and records should be preceded by certain activities aimed at organizing their content first (KIEDROWICZ, 2016a). Nonetheless, the activities shall not bring any expected results if the legal issues are not "settled". All of the above-mentioned registers and records operate pursuant to applicable provisions of law (acts, regulations, orders and procedures); it is only the right approach to the legislation processes, including all aspects related to the processed information, that would allow full application of the presented solutions (KIEDROWICZ, 2014b).

Unfortunately, legal systems in different countries are created in a different manner. Furthermore, many discrepancies exist within one country, which makes it necessary to perform additional activities or hinders integration of the data sources. It should be stressed here that the point is not to impose the method of law-making upon any country, but to show the consequences of subsequent use of IT resources. One way of solving this problem is, for example, to take actions at the level of EU regulations binding upon all Member States (usually in the form of recommendations).

Use and analysis of data

Use of registers and records

A possibility of integrating registers and records at a country level allows to obtain a lot of additional information on the basis of data that "everybody has had for a long time". For example, the use of address details of persons who committed crimes may allow to create detailed profiles of such persons. Additionally, it should also be noted that the address details are not only the data about the place of residence. The data may include the information on education (schools, clubs, sports/social organizations), out-of-school activities (courses, training, shopping places, favorite vacation spots), and work (places of work) of such persons. Each of the above-mentioned places has address and the activities performed therein by such persons - the so-called "time stamp".

What is also important, on the basis of the aforesaid data, it is possible to analyze the relationships and acquaintances of the persons of interest. The fact that somebody went to the same school means nothing. However, if this fact is put on the timeline and the school years turn out to be the same, it is highly probable that the persons knew each other. Similarly, if zip codes in the addresses of permanent residence (or street names/numbers) are analyzed, the likelihood that certain persons knew each other and hence belonged to particular social groups is higher.

Another example of extended data analysis may be the use of registers and records related to social and employee insurance. Such insurance is usually necessary due to the fact that a given person is employed somewhere (full-time work, casual work, temporary work). The employer is obliged to insure every employee. By using such registers, it is possible to define who worked for whom and in which period of time. Similarly as in the previous example, on the same basis, including the "time stamp", it may be determined with high probability whether the said persons know each other or not. Therefore, it is possible to state whether such persons worked at the same time for the same employer.

Another example refers to indirect relationships between different persons based on the shares (co-ownership) held thereby in economic entities (limited liability partnerships, joint-stock partnerships, limited partnerships). Such relationships are often hidden and invisible "at first sight". Searching for such relationships is not easy even if there is a register with all economic entities, including the shareholders (owners). It is often the case that a given person is the owner (co-owner) of the partnership, which is the owner (shareholder) of another partnership falling within the scope of our interest. The chain of connections often consists of many steps. It may include relationships, such as family ties. Seemingly complex links may be solved by using the proposed methods, without the necessity of obtaining any additional data.

It is especially helpful to use the network databases for searching such links. While considering the fact that the registers of economic entities are kept on the basis of hierarchical models, it is necessary to transform them into network databases and apply the already existing operational tools to work with such databases (CHMIELEWSKI, KOSZELA, 2012). The above example explicitly shows that it is possible to create a completely new quality of data analysis in a relatively short period of time and with little cost and effort. The use of the results of such analyses may bring additional effects in the form of new patterns of behavior, which may be applied to prevent certain types of crimes.

It is especially important for the crime prevention process. Having established the criminal's pattern of behavior, it is possible to define a possibility of occurrence of such pattern already at the early stage of its formation (subsection 3.2.). Therefore, certain preventive measures may be applied before an offense/crime is committed. It is also of key importance in case of crimes related to child abuse. Such crimes are hard to detect, thus, the best method is to take preventive steps that would reduce their number.

Processing of semantically similar data can be achieved using mechanisms that utilize ontologies and their reasoning capabilities. Such an approach have been described and evaluated for heterogeneous data processing in (CHMIELEWSKI, STĄPOR, 2017), providing process for instance base development and semantic assessment of instance associations.

Another example related to the use of public data sources refers to the registers and records of real estates (in many countries - called the "cadaster"). Generally, such registers include the list of all real estates (including lands and buildings) together with the appropriate scope of data. Their structure is "relatively simple", which allows integration of such registers and records in many countries. The integration process allows to obtain information on the real estates held by natural persons, but also – what is very important – the real estates indirectly owned by natural persons. The cadaster has attributes related to the owner/owners of the real estates, i.e. either a natural person or legal person (economic entity). As already mentioned in the preceding example, while using the information available in the registers of economic entities (and their owners/shareholders), it is possible to find all real estates of a given person. Such list includes both the real estates directly "ascribed" to such person and the real estates that belong to an economic entity owned by such person. As previously, the links may be multi–level, so their analysis shall be more efficient if the hierarchical databases are transformed into the network databases.

The above-described examples show great potential of the already existing data sources. The registers and records, which were created in the last century and which are currently updated and used, allow to obtain basic analyses and information – i.e. such that have already been defined at the time of their occurrence. The application of current IT methods and tools allows to obtain additional information, without the necessity of altering such methods and tools. Another good example is the use of RFID technologies and GPS solutions in combination with biometric techniques (Figure 4).

When using the population registers (register of citizens, including data on their places of residence) and ID document registers (passports and/or ID cards with biometric data), it is possible – including RFID and GPS technologies – to create a new quality of identification, location and monitoring

processes of certain persons (KIEDROWICZ et al., 2016; KIEDROWICZ, 2016c). The application of such solutions in activities related to crime prevention (also child abuse) may be twofold. First, it is possible to track a potential offender and second – to monitor a potential crime victim. In both cases, the persons do not have to be aware of such actions undertaken with respect thereto.

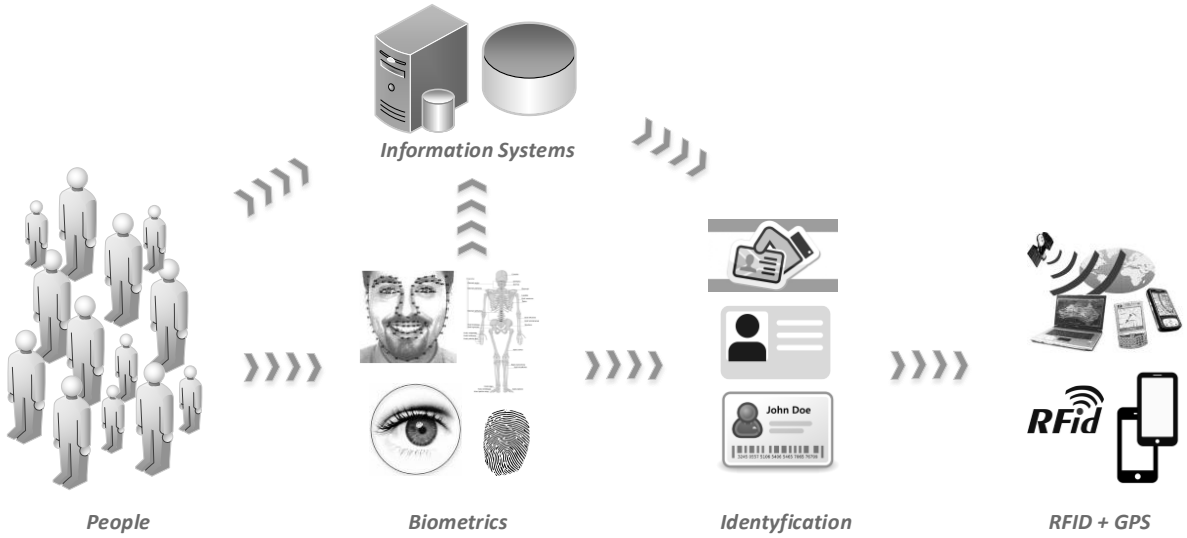

Fig. 4. Application of biometrics, RFID and GPS technologies to monitor persons.
Source: Own study based on (KIEDROWICZ, 2016b).

Collaborative systems, including those as shown in Figure 4, can be verified using simulation methods (WASZKOWSKI et al., 2016). It examines both the characteristics of information flow as well as the reliability and performance of the systems themselves and the connections between them. Similarly, the work of teams designing data analysis systems in state registers may be the same (NOWICKI et al. 2017). Correct functioning of project teams allows for fast and efficient tooling to examine the relationships between information in individual public registers.

Outline of the data analysis method

The selection method is often used to combat all types of crimes. In the discussed case, its application may produce additional effects, such as appropriate direction of preventive measure, which entails improved efficiency of such actions.

The following diagram showing the working method includes application of the selected source data. The use of the real estate database sources was stressed in the article. However, the data sources which are commonly used (e.g. recognition and assessment of child abuse symptoms, dialog with parents about the family situation and family relationships, conversation about the methods of bringing up children, home visits, etc.) were omitted. Some examples were deliberately exaggerated to show a possibility of non-standard application of data, which are "seemingly" unrelated to the examined cases.

1. Analysis of the known cases of child abuse from the perspective of criminal profiling
   a. For instance, a criminal often moved (changes his/her address of residence) and always bought an old warehouse or storehouse located in a remote place, within 20-30 km from the city/town, where he/she lived.
   b. For instance, the criminal is 35 years old and has a secondary level of education.
   c. For instance, the criminal has a truck.
   d. For instance, the criminal pays bills on a regular basis.
2. Development of patterns of behavior of child abusers:
   a. For instance, the criminal often moves (buys a house/apartment) and buys an old warehouse or storehouse together with the property.
   b. For instance, the criminal is 30-40 years old and has a secondary level of education.
   c. For instance, the criminal has a van or combi vehicle.
   d. For instance, the criminal has no problems with any tax office.
3. Analysis of available data sources in terms of the previously occurring patterns ("selection"):

a. For instance, the criminal has the warehouse/storehouse near his/her place of residence (20-30 km) and/or the criminal often changes the properties. No business activity is run in such property.
b. For instance, the criminal is 30-40 years old and has a secondary level of education.
c. For instance, the criminal has a van or combi vehicle.
d. For instance, the criminal pays taxes on a regular basis.

4. Child abuse prevention by monitoring potential criminals or children selected at the previous stage.
   a. For instance, preventive patroling/monitoring of such facilities.places.
   b. For instance, extended analysis of personal details of the selected person.

It is possible to define the "degree of fulfillment" of the pattern. For example, 90% of the criteria referring to a possibility of occurrence of a certain event (crime) were met or each of the criterion is met in at least 80%. Only such cases shall be subject to further analysis and use.

The suggested use of the various data sources shall bring measurable effect only when they are analyzed as one, integrated data source. The more elements are taken into consideration, the more accurate the results of the analysis shall be. It should be emphasized that, at the final stage, it is a human being that determines further steps and that the aforementioned methods are only to support other activities (e.g. as indicated in (PAAVILAINEN et al., 2014)).

Conclusions

The data sources, which are seemingly independent, provide vast possibilities of obtaining new and important information. Such activities are referred to as in Big Data (KIEDROWICZ, 2014b), however, the term is often misused. Nevertheless, one important assumption is forgotten – namely, the data should be unstructured, and there are no methods or tools (automatic or based on IT), which would provide for such a possibility of operations with the data. Otherwise, we have to deal with ordinary data, which are larger (in quality and quantity).

Furthermore, it should be noted that the above-mentioned possibilities of using public registers and records must cover the entire environment, in which they are used. The above refers to data connected with the environment, data from police and prosecutor's records, statistical data on behavior of criminals and their victims as well as data covering legal, social, economic and often also religious environment. It is also essential to consider all aspects resulting from the necessity of observing human rights, in particular the issues of personal data protection, which may differ depending on the country.

The article deliberately omits the issues concerning modern solutions related to the use of, for example, data from social networks or billing information, and tools applied for analysis of such information. It is also possible to find a large number of current publications, which discuss these issues and show numerous possibilities of their use, for example, to combat and prevent crimes related to child pornography and child abuse.

Another important issue that needs to be discussed refers to the ethical aspect of data protection, especially as regards personal data. Different countries apply different solutions related to data protection. In Europe, Regulation 679 (REGULATION (EU) 2016/679) and Directive 680 (DIRECTIVE (EU) 2016/680) on the protection of natural persons were implemented. In many countries, the crimes of child abuse are not prosecuted, which means that in such cases, the preventive actions are even more important. Ethical issues resulting from tackling sensitive (often impossible to measure) aspects of child abuse are very important. Another topic of key importance refers to crime prevention through education and awareness raising of individuals and entire social groups.

Finally, it should be stressed that the article does not provide explicit solutions of great problems resulting from the need to detect crimes related to child pornography and child abuse. The objective of the article is to show additional and feasible activities, which could increase the efficiency of all actions of authorities and persons involved in the fight against such crimes. In particular, such efficiency may be increased in case of combination of all data sources ("old" and modern) and application of various methods and tools supporting the data analysis.

The article proves that with little cost and effort, it is possible to efficiently combat and increase detectability of pathology related to child abuse, and – what is more important – to better prevent such crimes.

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