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It is represented that book articles will be interesting for experts in the field of information technologies as well as for practical users.

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A COMPREHENSIVE APPROACH AND USER-ORIENTED POLICY FOR MANAGING RISK AND SAFETY

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***Abstract**: A possible approach for more flexible and user-oriented risk assessment methodologies and creating infrastructure for exchanging and processing spatial data in Europe is outlined in the paper. Priority is given to setting up a network of servers in different parts of Europe which work in harmony and constitute parts of a unified system, integrated with a network of regional units for risk and security management. Such approach is considered in many respects to be better, more effective and yielding faster and better quality results than the creation of centralized structures – a super-server where primary data are fed by various municipalities, regions and countries, or international super - agency for risk and security.*

***Keywords**: Infrastructure for spatial data in Europe, user-oriented risk assessment methodologies, network of servers, network of regional units for risk and security.*

***ACM Classification Keywords:** C.2 COMPUTER-COMMUNICATION NETWORKS, C.2.5 Local and Wide-Area Networks,*

Introduction

If one needs to know what is the time, he or she may ask someone and will know "the local" time. But if one wants to know what time is pointed by all watches in the town or in the country, it is really impossible to solve such problem because of the high number of devices - it is impossible in the same moment to scan and receive all information. During processing one part of watches, the other will show new time. So, one will never know what time is on all watches.

In other words, along with modern technologies appears a lot of information. Often, when we want to collect and understand it, the traditional methods are not enough. They might be too general and they need additional processing and transformation. Therefore we use advanced methods of data processing such as rough sets, genetic algorithms, neural nets or fuzzy sets. Rough sets have application e.g. in problems of excessing data, problems with correct classification or problems with retrieval hidden relations between data. Placing these methods in environment of distributed applications, based on.Net platform and XML Web Services, introduce new possibilities in usage of artificial intelligence methods in data processing systems [Zielosko and Wakulicz-Deja, 2005].

Technological advancement in using intelligent techniques has provided solutions to many applications in diverse engineering disciplines. In application areas such as web mining, image processing, medical, and robotics, just one intelligent data processing technique may be inadequate for handling a task, and a combination or hybrid of intelligent data processing techniques becomes necessary. The sharp increase in activities in the development of innovative intelligent data processing technologies also attracted the interest of many researchers in applying intelligent data processing techniques in other application domains. [Wai Wong et al, 2007]

A briefly classification of the existing methods of data processing by the complexity of results that we want to achieve is given in [Nguyen et al,1997]:

- In some problems, all we want is one or several numerical values. It may be that we measure some characteristics, or it may be that we know the model, and we want, based on the experimental data, to estimate the parameters of this model. These problems are usually handled by statistical methods.
- In other problems, we want to know a function. We may want to reconstruct an image (brightness as function of coordinates), we may want to filter signal (intensity as a function of time), etc. These methods are usually handled by different regularization techniques.
- Finally, there are even more complicated problems, in which we want to reconstruct a model of an analyzed system. Methods that handle such problems are called ***intelligent data processing methods***.

> Many of these methods are based on logic programming, a formalism that (successfully) describes complicated logical statements algorithmically, in a kind of programming language terms. Other methods are based on advanced information modeling technologies which use rough sets, genetic algorithms, neural nets, fuzzy sets, etc.

A very important area for applications of the intelligent systems is the European Earth Observation Program (GMES – Global Monitoring for Environment and Security) which provides data useful in a range of issues including climate change and citizen's security. Land, sea and atmosphere – each Earth component is observed through GMES, helping to make our lives safer. The purpose of GMES is to deliver information which corresponds to user needs. The processing and dissemination of this information is carried out within the "GMES service component" [GMES, 2010].

The thematic areas within the GMES service component comprise:

- land, marine and atmosphere information – ensuring systematic monitoring and forecasting the state of the Earth's subsystems at regional and global levels;
- climate change information – helping to monitor the effects of climate change, assessing mitigation measures and contributing to the knowledge base for adaptation policies and investments;
- emergency and security information – providing support in the event of emergencies and humanitarian aid needs, in particular to civil protection authorities, also to produce accurate information on security related aspects (e.g. maritime surveillance, border control, global stability, etc.)

Managing natural resources and biodiversity, adapting to sea level rise, monitoring the chemical composition of our atmosphere: all depend on accurate information delivered in time to make a difference.

The GMES service component depends on Earth observation data, collected from space (satellites), air (airborne instruments, balloons to record stratosphere data, etc.), water (floats, shipboard instruments, etc.) or land (measuring stations, seismographs, etc.). These facilities are called the GMES infrastructure component; non-space based installations in the GMES infrastructure component are generally referred to as "in situ component".

By securing the sustainability of an information infrastructure necessary to produce output information in the form of maps, datasets, reports, targeted alerts, etc., GMES helps people and organizations to take action, make appropriate policy decisions and decide on necessary investments. GMES also represents a great potential for businesses in the services market, which will be able to make use of the data and information it provides according a full an open access principle.

Earth observation-based services already exist in Europe, but they are dispersed at national or regional level and cannot rely on a sustainable observation capacity. With the exception of meteorological services, long-term availability and reliability of information is not guaranteed. This is why, in order to contribute to improve its response to ever growing challenges of global safety and climate change, Europe develops a sustained and reliable Earth observation system of its own [GMES, 2010].

The growing frequency of natural disasters, their serious impacts and huge damage have become to be considered one of the modern challenges of the countries in Europe. Some of the weak points in the European policy and activities in this field are - the lack of prognosis and user-oriented preliminary risk assessment of potential damages in different regions as well as a simple to be used but powerful in data processing information infrastructure. The issue of having a preliminary assessment of the likely damage and ways to mitigate or even avoid it has attained an ever bigger significance but it must be developed in parallel with improving and fostering the transfer of data, information and practices, without losing the local and regional user’s priorities.

The experience gained in recent years from various national and international projects aimed at finding solutions to minimize damage from natural disasters and creating workable models of forecasting and assessing potential future damage reveals two components as being major factors for achieving good results: (1) a good methodology and (2) access to the necessary spatial data and information systems. Given that there have already been developed methodologies and simulation models of the respective disaster, what remains an open issue is ensuring the necessary data, in an appropriate format, with the relevant compatibility so that they can be combined with other data and processed as a package so as to obtain the required synergy effect and results as close as possible to the real ones. The basic approach, presented here is to start with developing a simple and much general model of a possible natural hazard (an earthquake in this case), using the available information from different sources and open to be upgraded and improved parallel to the increase of the amount of available data sources.

One possible approach for creating an infrastructure to ensure such exchange of spatial data and their processing is to set up a network of servers in different parts of Europe which will work in harmony and constitute parts of a unified system. Such an approach is considered in many respects to be better, more effective and yielding faster and better quality results than the creation of a central server where primary data are fed by various municipalities, regions and countries.

In this connection some key aspects of information security and use of information technology in information systems related to management of Critical Infrastructures, should be considered [Polimirova et al, 2007a]. The main point in the analysis of the threats to the Information technology is the planning and implementation of attacks to information resources in general [Nickolov and Polimirova, 2010] and in particular to the information objects [Polimirova et al, 2007b]. Depending on the environment and client-server architecture different types of protection of information systems used in Critical Infrastructures can be built [Polimirova and Nickolov, 2009], [Polimirova and Nickolov, 2010]. It is necessary to investigate also the issues related to the risk assessment that could be applied to information objects, which are a part of information systems operating Critical Infrastructure [Polimirova, 2008]. This concept closely correspond to the proposal of the European-Mediterranean network of regional units for risk and security management, presented on the GMES Workshop in Sofia, in March, 2010 and included in GMES Workshop Sofia Conclusions [GMES-WS, 2010].

General overview

In the course of several millennia the human evolution turned the human being from someone who inhabited forests and various natural earth cavities into a geological factor who built first small, and then ever bigger and bigger artificial complexes - buildings grouped in even grander zones: population and industrial agglomerations. The matter moved to be input in these urban agglomerations is commensurate with the quantity expelled by major geological disasters - volcanic eruptions, or moved by tectonic processes - earthquakes.

Irrespective of his incessant effort man cannot yet boast that he has tamed the natural force and the cyclic occurrence of hurricanes, earthquakes, fires which wreak havoc and claim many lives. No one has yet "won a battle" against a natural disaster; one can rather speak of avoiding the worst and mitigating the damage. This is why a "winning war" with nature would need a careful preparation of "the next battle" - an appropriate system for forecasting of possible disaster-induced damage and the strategic planning and preventive measures that go together with it.

The growing frequency of natural disasters, their serious impacts and huge damage have become to be considered one of the modern challenges of the countries in Europe and all over the World. The issue of having a preliminary assessment of the likely damage and ways to mitigate or even avoid it has attained an ever bigger significance.

The experience gained in recent years from various national and international projects aimed at finding solutions to minimize damage from natural disasters and creating workable models of forecasting and assessing potential future damage reveals two components as being major factors for achieving good results: a good methodology and access to the necessary spatial data and information systems. Given that there have already been developed methodologies and simulation models of the respective disaster, what remains an open issue is ensuring the necessary data, in an appropriate format, with the relevant compatibility so that they can be combined with other data and processed as a package so as to obtain the required synergy effect and results as close as possible to the real ones. Thus good methods, simulation models and software are reduced to zero when data sources are not available or they are not accurate, updated and easy for use. The problem is related to the adoption of common rules for data exchange, data storage and formatting, etc., which are the subject matter of European

Directive 2007/02/EC [INSPIRE, 2007] setting the legal framework for the establishment and operation of an Infrastructure for Spatial Information in the European Community (INSPIRE) [INSPIRE TR, 2007], but which also call for the introduction of rules vis-a-vis interoperability of the information systems.

Therefore the presented article is combining research and development topic – as modeling preliminary losses from natural disasters (earthquake in this case), and conceptual topic – as the development of a quality assurance reference data base and regional networking for data storage and processing and for risk and security management.

It is common knowledge that proper measures taken beforehand reduce many times over the damage from a possible natural disaster as well as the resources and money necessary to overcome the consequences. Given that a natural disaster may strike at a particular place but can affect a large geographical area sometimes covering several countries, the work should be aimed at achieving coordinated estimates and measures simultaneously, on the local, as well as on the inter-regional, community or even global, level.

This is why the respective methodologies, spatial databases, simulation models and outputs need to be compatible, aimed to achieve a synergy effect and create a platform of interoperability.

Five levels of management are identified: (1) municipality; (2) country; (3) region; (4) European Union; (5) global level. Halfway levels are possible too, such as unification of policies for risk management in a given area of impact, for example the catchments areas of big rivers. A good example of this would be the creation of an integrated system for prevention against flooding and water pollution along the Danube within the future European Danube Strategy [EU Strategy, 2010]. The European Danube Strategy, set up in October 2008 [Declaration, 2008], recognizes the need for an expansion of coordination between the 10 Danube states – of which six are EU member states. The Danube area has a population of 200 M inhabitants, of whom some 70 M live in regions directly situated on the banks of the river.

In respect of earthquakes, an intermediate form of unification could be sought of policies for risk management in areas affected by known seismic foci or geological areas, e.g. significant faults in contact areas of tectonic plates.

Set out below is an opinion about the necessary exchange, and in certain cases, integration of spatial databases and information systems regarding seismic risk.

Methodological basis

The methodology for forecasting damage caused by natural disasters, particularly earthquakes, mainly targets the residential urban environment and the public utility and industrial infrastructure related to it, which make up the modern city. The methodology complies with the requirements to yield results that are useful for the end users (local and central powers, business entities, civil protection), as well as to tackle the existing problems with the available spatial data, unreliable information and absence of information.

Why is such a methodology an indispensable element of the effective policy for managing risk and safety?

This is so for a number of reasons, namely:

- Buildings differ in type, mode of construction and age, and thus have different vulnerability to catastrophic seismic impacts, so that the damage they will sustain will be different;
- The modern urban society has never had such surplus of energy, resources and temporal capacity so as to allow the construction of buildings able to withstand the possible maximum seismic impacts;
- Rigorous construction supervision is missing (especially in the time passed); many violations are made on town-planning indicators and the requirements for free spaces and distances between buildings, laid down for safety reasons;
- The policy for sustainable development calls for judicious spending of resources for prevention against seismic impacts, allowing such expenditure only where the alternative to building a new earthquake-proof building or the reinforcing of an old one would yield an immediate positive effect for the public,

either in terms of safety and quality of the living space, or as industrial economic infrastructure, or also as protection of an intangible value of historical or emotional essence;

- Recently we have witnessed (in Bulgaria) a dangerous scheme used by developers who opt for fulfilling their interests by contravening the law and even creating a threat to people's lives and health. In the scheme certain buildings which have public significance, constitute monuments of culture, or are banned from demolition by law, are left in disrepair or else their process of degradation is accelerated artificially, so that they reach the stage of self-destruction and can thus be freely removed and replaced by a new development project which usually exceeds considerably the permitted town-panning parameters. The scheme in question poses a double threat - on the one hand the disintegrating building poses a threat to the members of the public and to the buildings and infrastructure next to it (a fatal accident of this type occurred in Sofia only two years ago), and on the other, the new construction usually fails to comply with the safety criteria and standards and becomes a potential threat during a future earthquake.

Driven by various reasons the modern society (and particularly United Europe) has developed adequate methods for observing a given disaster and for managing economic flows during recovery; however, a single methodology is yet missing for forecasting disaster-induced damage, including in terms of individual risks and topics. This is especially true of places where the data necessary for making the estimates are rarely available in the necessary volume, accuracy and credibility.

In such a case the option is to look for a methodology that is "sustainable" and resilient to data incompleteness, a methodology that is nevertheless applicable, albeit with a reduced accuracy of results. The most important thing in this case is for the methodology to provide a good idea about the areas with increased risk and a reliable general assessment of the likely damage. The methodology needs to be able to be applied both at the local level - a neighborhood or a town, as well as at a greater one - a region or a country. At the next stage partnership is to be sought with experts and structures from neighboring countries to ensure interaction between such methodologies of two countries or more, as well as the exchange of data, models and results.

Such a methodology will prove very useful for risk assessments vis-a-vis urban centers with limited data about housing and public utility infrastructure.

The methodology takes into account the state of the spatial databases and information systems in Bulgaria and the actual difficulties in providing full, detailed and objective information. In this respect the situation in Bulgaria is similar to that in many other EU member states, meaning that the methodology can be successfully applied in the EU, as well as in other geographical regions.

The methodology, developed by a team of experts in different areas: geophysics, economy, town planning, informatics, has three successive layers:

1. risk assessment of housing;
2. risk assessment of public utility and economic infrastructure;
3. assessment of economic damage.

Assessment of the so-called "intangible damage" has not been envisaged, as at this stage it proved impossible to validate in the respective software the connection between intangible or information values and current tangible values and assets of the modern city.

Several versions of the methodology have been set out:

- for assessment of earthquake-induced damage of residential buildings;
- for an overall assessment of the seismic risk;
- for estimation of the economic losses from natural disasters.

These methodologies will be outlined shortly below. Detailed explanation will be given in further publications.

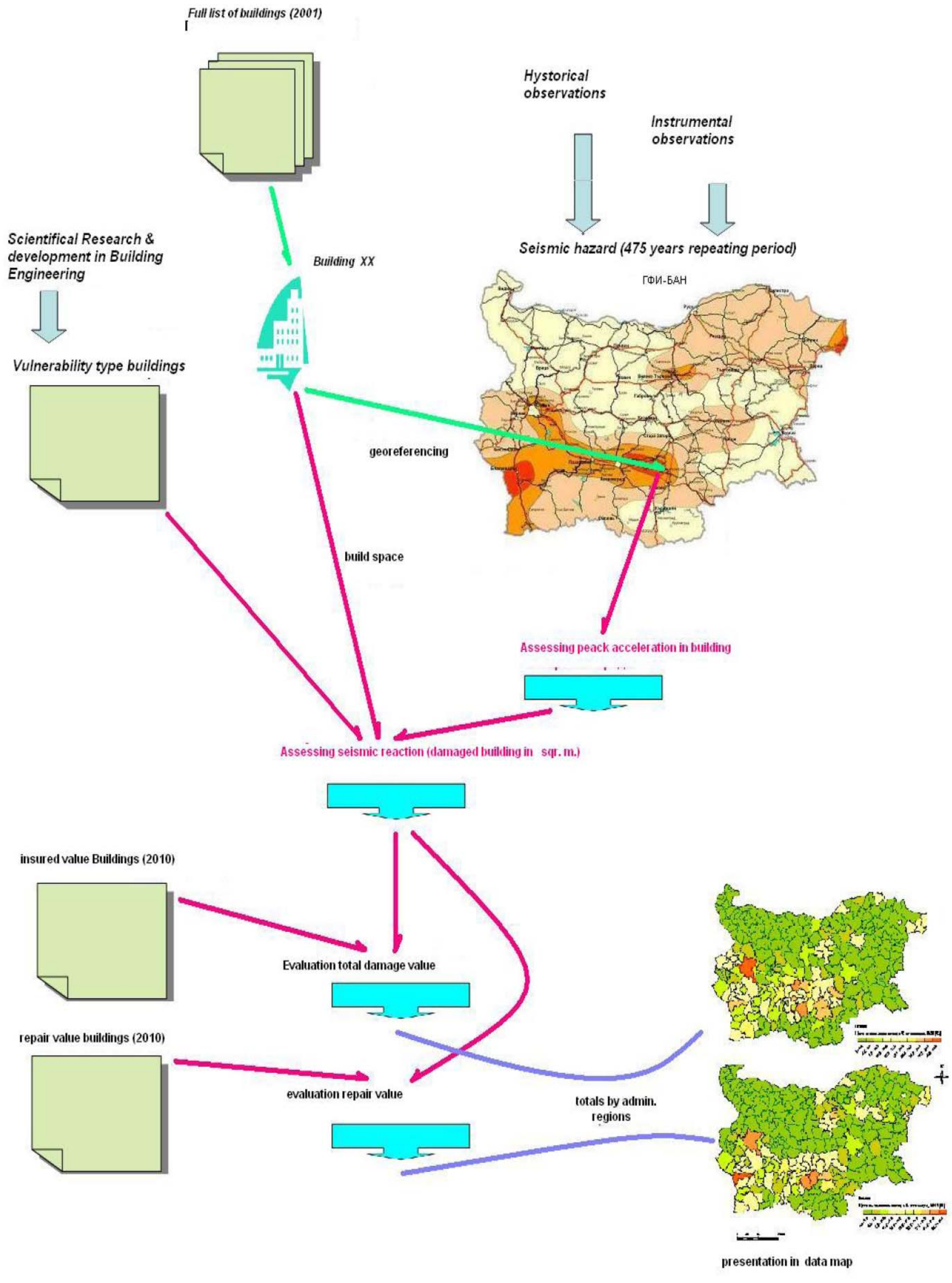

Figure 1. Simplified methodology for seismic damage assessment of dwellings

Methodology for assessment of earthquake-induced damage of residential buildings at the level of municipality, district, country, region

The methodology has been used on test cases for the Bulgarian cities of Sofia, Ruse, Vraza and for the whole country. First priority was given to results which can be of use for the local and state administration for planning their economic and resources actions as well as for urban planning, building rehabilitation and civil protection.

The methodology is based on experience gained from work under the RISK-UE project in Europe [Mouroux and Brun, 2006] and HAZUS in the United States in the late 1990s and the beginning of the new millennium [HAZUS, 2010]. It starts from:

- availability of data about catastrophic impact (in the region);
- availability of data about housing (in the region);
- availability of a vulnerability function (vis-a-vis the respective housing related to catastrophic impact by type of buildings and type of impact).

To obtain an assessment of the expected damage, systematic modeling is made of the catastrophic impact for each registered housing object, depending on the planned maximum catastrophic impact.

The methodology concerns assessment of the likely damage on residential buildings caused by an expected earthquake with a given magnitude. It is applied on information about housing and the occupants thereof available in the respective National Statistical Service. The methodology is apt to be applied in assessing the value of small to medium damage (for example, up to 20-25% of the area), whereby the recovery value increases non-linearly when the percentage of damage is higher, as costs will be provided for clearance.

The methodology is illustrated by the brief scheme shown on Figure 1.

Methodology for overall assessment of earthquake damage

The methodology is in the process of being developed; the authors have set themselves the task of extending it (for housing infrastructure) to include the public infrastructure (the urban infrastructure in particular) in the actual situation of missing workable databases about buildings and other urban infrastructure. To this end, partial use is made of the methodology for structuring of the urban infrastructure in the European project RISK-UE (WP3) [Mouroux and Brun, 2006], presented on figure 2.

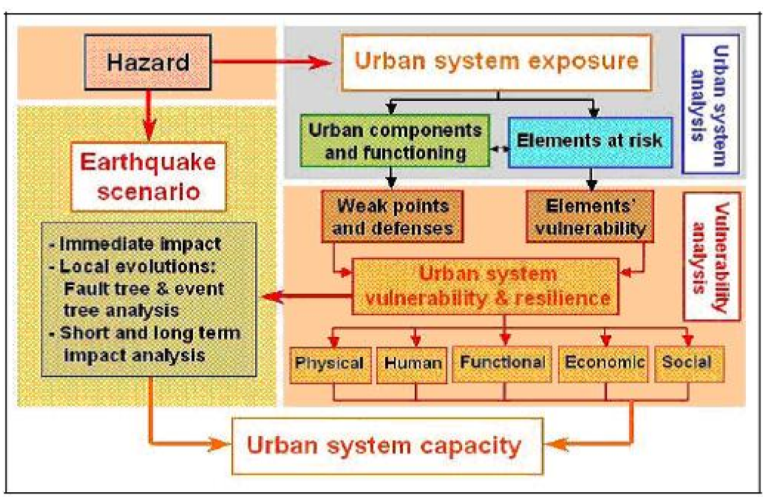

Figure 2. GEMITIS' Seismic Risk Analysis [Masure and Lutoff, 2006]

From the overall approach, the part covering the elements at risk complementing housing is being extracted.

The simplest option would be to apply the basic methodology on sets of infrastructure descriptions. But here lies the main obstacle, in this case - for Bulgaria - the absence of a detailed and comprehensive description of this infrastructure.

Extrapolation of the housing damages to damages in the public infrastructure

A more complex option would be to arrive at a system for extrapolation of the public housing data to a mechanism for assessment of infrastructure data as a main task in risk assessment.

Solving such a problem is not possible using simple linear extrapolation of housing damage (a purely physical assessment).

In the first place, the purely housing damage - provided that it does not exceed a minimum percentage (e.g., 5%), can be serviced in fully functioning infrastructure (i.e., without, or with only negligible losses in the public infrastructure). Then recovery is seen as part of the normal functioning of society, rather than an emergency activity. This is why losses in the public infrastructure should be considered from a certain threshold and above.

After the initial version, mechanisms can be applied as well for taking into account the impact of losses in the public infrastructure in the sub-scheme of their structuring according to the above mentioned model of WP3-RISK-UE [Mouroux and Brun, 2006]:

- vis-a-vis physical damage (collapsed buildings) of the public infrastructure;
- vis-a-vis functional damage of the public infrastructure (impossibility to function fully);
- vis-a-vis economic damage (from own collapsed facilities and from a diminishing workforce busy with recovery of primary needs);
- vis-a-vis functional and economic damage from newly emerging urgent social&material needs;
- vis-a-vis "social" (non-material historical, marketing and similar) damage as a result of the disaster which diminishes the economic value of the respective area.

Further, mechanisms are applied for transformation of housing damage to damage on the public and economic infrastructure. Some preliminary conditions are accepted as:

- Going beyond a certain percentage of damage (e.g., over 10%) suggests additional costs for rescue, evacuation of population without shelter, setting up of medical aid, security and safety, provision of food for the population remaining in place. Hurricane Katrina, and even more so, the earthquake disaster in Haiti, revealed the considerable shortage of capacity of the security services in the event of a large-scale disaster;
- In the case of more than 10% affected (destroyed) housing, emergency costs are to be provided for temporary housing to shelter the surviving population until recovery of at least 60% of the volume of housing from before the disaster.
- Going beyond a certain percentage of damage (e.g., over 5-10%) suggests non-linear increasing of costs for site clearing. If more than 35-50% of the housing has been affected (has collapsed), from 10% to 40% costs (of the building value) should be provided for site clearing and environmental-friendly processing of waste.
- As a rule, the normal construction activity for a given region is determined as being designed to build/recover no more than 5% of the available housing (i.e., a term of restoration of housing of no less than 20 years). Above this percentage all activities for clearing and restoration constitute additional capacity for construction and repair works which is not available *in situ*.
- More than 35-50% affected (destroyed) housing suggests total destruction and a need to build anew the houses affected by the disaster.
- When the affected (destroyed) housing exceeds 10%, a relevant percentage of destruction of public utility infrastructure should be assumed - schools, hospitals, which could vary from 5% to 15-20% of the value of the housing (depending on the characteristics of the social environment at the place of the disaster).

This should be taken into account, irrespective of the application of specially heightened seismic requirements vis-a-vis such public buildings in certain areas (e.g., in the United States). When more than 40-50% of the housing has been affected, total destruction of the subsurface public utility infrastructure servicing the given housing should be assumed. Respectively, rebuilding of the public utility infrastructure should be provided for.

- In recovery actions in a region heavily hit by a seismic disaster, costs for the transport infrastructure should also be provided for, which need to be higher than the prices of such infrastructure during normal times of construction.
- When more than 15% of the public utility infrastructure has been affected (destroyed), urgent building of temporary replacement public utility infrastructure should be provided for.
- In the event of a seismic disaster (affecting more than 5% of the housing), shortage of construction capacity should be assumed at the place of recovery and a subsequent increase (sometimes multiple) of the economic value of the restoration in relation to the own value of the destroyed infrastructure (both housing and public infrastructure).

Extrapolation of the housing damages to the economy

Together with the social and public utility infrastructure, a seismic disaster will also damage the economic infrastructure of the given region. In such case, the increase of damage is non-linear and non-proportionate (as set against that of housing) (Figure 3.).

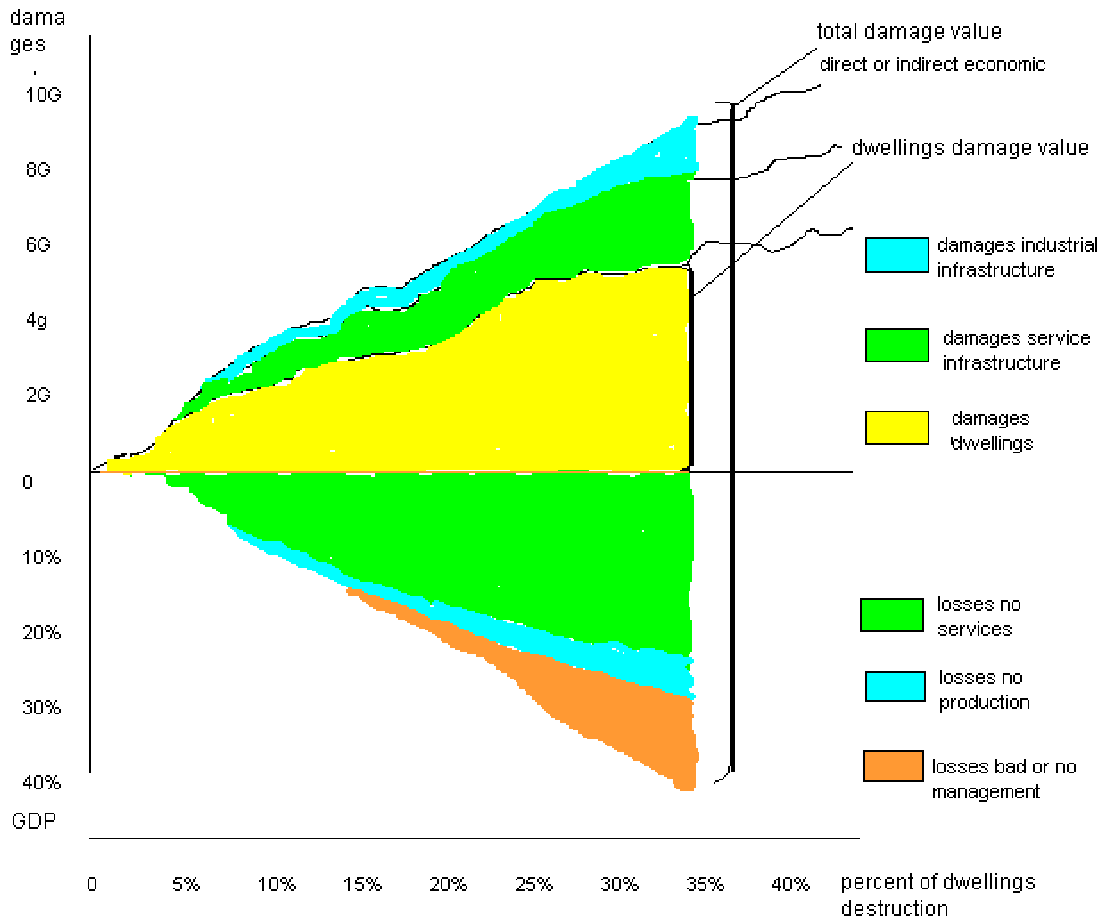

Figure 3. Non-linear, non-proportionate (as set against that of housing) increase of damage

The reasons for this are:

- In the modern societies the economy constitutes up to 70% services (commerce, public utilities, energy supply and supply of staples, education, medicine, administrative services), which are proportionate to the available housing infrastructure and which are affected/destroyed in the same degree as the housing infrastructure.
- For example, in the observation of the restoration works after the 2008 earthquake in China, destruction of a considerable part of the existing economic sector was observed on the one hand and on the other hand the replacement thereof by a newly-emerged construction sector for restoration funded by the Chinese budget.
- The industrial economic infrastructure will reduce its capacity by a given percentage of the overall damage to the housing but only within certain limits of the total disaster (for example, up to 20-30% of the housing). Individual sectors may witness less reduction when they are related to restoration of the infrastructure (construction, etc.). Above this percentage anticipatory increase of the damage of the industrial infrastructure can be expected, in parallel with the reduction of the workforce being used on the one hand (which has been redirected to salvage and restore housing), and on the other, on account of the destroyed transport infrastructure, and still other, on account of a change in the local consumption caused by the restoration boom.
- Depending on the geographical location of the industrial facilities, they too sustain damage, proportionate to that of the housing infrastructure. In the majority of industrial productions, the damage caused by a seismic disaster can cause an additional disaster: fire, pollution with chemicals, bio-agents, radioactive substances, etc., gazing, flooding, etc., which (depending on the concrete industry) can increase the damage to more than 500% from the initial value of the industrial facility.
- In large-scale disasters there inevitably occur economic losses due to a need for restructuring the economic infrastructure.

Methodology for assessment of economic damage from natural disasters

This methodology constitutes an extension of the methodology for determining the total damage from a seismic disaster. In the presence of a baseline system for assessing housing damage caused by a catastrophic natural disaster (with taking into account of the "national" peculiarities), it is possible to make a multiplication scale which identifies parallel and subsequent damage on public utility and industrial infrastructure, and thus, an assessment of the relevant economic losses. A next step should analyze the cumulative effect from non-direct impacts, intangible assets, stress and psychological breakdown of big masses of the population.

A percentage of loss/destruction of public utility and industrial infrastructure commensurate to the housing infrastructure should be accepted as a basic criterion for economic loss, whereby the said infrastructures generate:

- public utility services (including transport, energy, communications, water and sewerage);
- material flows from industrial infrastructure;
- as a consequence of a reduced GDP - reduced tax revenue, restrictions/cuts in the government budget intended for restoration;
- additional reduction of the capacity for restoration and, respectively, the rates of GDP recovery.

Undoubtedly, a more precise assessment would be yielded by precise modeling of a "facility at risk" from a detailed map of the locations of public utility and industrial infrastructure compared to the map of the magnitude of the catastrophic impact via the vulnerability function, when such a map appears. At the moment information about the presence of such an integrated map is not available for any country in Europe.

As we said earlier, the public utility services are closely linked with the housing and the destruction of the former ties in very well with the damage on the latter. It is logical to recalculate the total volume of affected public utility services, via the square meters of housing area and the total lost/damaged square meters of area.

Example

By way of an example we offer below the preliminary assessments about Sofia, without claiming that they will not be adjusted when additional information and up-to-date data are provided.

Output data about Sofia, 2007
Gross Domestic Product 20,576,000,000 leva
Gross Surplus Product 16,900,000,000 leva
Redistributed via budget - 40% of the GDP, or 6,800 M
Breakdown: Services 78.5%
Industry 21.2%
Forestry and farming 0.3%
In services - 8.5% (increased, prior to that about 5%) construction, which will not decrease in the case of disaster.

With a total GDP per annum (2007) of 20,576 M for the territory of Sofia City, and projected maximum damage of 32% of the housing area, the total planned economic loss from services will be 5,530 million Bulgarian leva, or about the size of the direct damage of the housing lot.

The impact on the industrial sector (extracting and processing industry) of a seismic disaster as an assessment from a correlation with damage on housing is weaker than that of the service sector. Here we first have an impact threshold (above 5-10% affected homes from a separate industrial area). Secondly, the industrial activity is concentrated in separate industrial zones, mostly outside population centers, so that heavy damage of high-rise housing would not have a significant impact on the industrial capacity. In this context it can be safely assumed that the percentage of damage of the industrial infrastructure will be no more than half of that of the housing infrastructure.

If we again take as an example Sofia City, the estimated projected economic losses would be to the tune of 411 million BG leva, or nearly a ten-times lower impact than a disaster in the service sector.

The occurrence of additional damage due to events caused by the primary disaster, such as fires, people/equipment buried under ruins, flooding, pollution, etc., has relevance only for specific industrial infrastructure. In conducting a preventive analysis, a study should be made of available major industrial or energy facilities where a fire, pollution, flooding could occur in the case of disaster.

An additional damage from a disaster in the area of Sofia could be expected in the form of above-proportionate shrinkage of wholesale trade (up to 20-30%) and mostly, above-proportionate reduction of administrative and governance services since the administration is concentrated in the area of Sofia. Then the ensuing economic effect could reach up to 20-50% of the economic losses from services, or in the case of Sofia, this would mean another 2,000 million leva in damage.

The damage from necessary restructuring of the economy following a disaster is difficult to estimate precisely enough.

Conclusion

It is clear for most experts that there is little likelihood for a comprehensive methodology yielding as truthful results as possible to be devised in the next couples of years in the European Union. Examples for such failures are found in risk prevention in the United States in cases such as Hurricane Katrina, in Europe in the recent flooding in Central and Eastern Europe, the earthquake in China, etc. Thus, above all we want to promote the pragmatic step-by-step approach in the creation and application of methodologies and models for risk management first on regional level, with a possibility for parallel verification in situ. Developing of regional focal units, engaged in a large network, covering the EU and later larger regions is a probably the best sustainable solution.

The absence of sufficient information in terms of diversity, up-to-date relevance and correctness makes it necessary to look for effective use of the available data, whereby in most cases these constitute statistical information.

Two mainstays need to be used in order to achieve good results:

- European directives and regulations;
- Strengthening the cooperation within the broad European area which includes both EU member states and neighboring countries, based on the user oriented approach which is better achieved if the regional and networking concept is accepted.

We need elaboration of national methodologies, simulation models and analytical models for damage assessment, based on local data, which are subject to constant coordination and harmonization and in direct connection with the user - national governments, civil protection units, local authorities. In this sense a main partner of the regional and national teams could be some structures of the European Commission as the Directorate General Enterprise and Industry (more particularly, the department for Competitiveness, internal market for goods and sectorial policies), Directorate General Humanitarian Aid, Directorate General Joint Research Centre (more particularly, the Institute for the Protection and Security of the Citizen).

Meanwhile, a number of countries, as well as European structures, have set up relevant websites with up-to-date information for expected or past disasters. It would be a good thing if, on the basis of peer initiatives, and in addition to the information they upload, these sites adopt a unified system for presentation of information, including:

- Automatically uploaded up-to-date information about actual events, including by regions and topics, e.g. fires, flooding, etc.; the information should be stored and accessible by time periods, e.g. weekly, monthly, yearly;
- The system should be open for inclusion of other sources of information, as well as for making comparative analyses;
- The system should also include addresses of local, national and European structures responsible for making of forecasts or for actions in the case of natural disasters.

In this presented above sense good opportunities are presented by:

- the European Directive 2007/02/EC setting the legal framework for the establishment and operation of an Infrastructure for Spatial Information in the European Community (INSPIRE), Directive 2003/98/EC on the re-use of public sector information and others;
- the creation of regional, and subsequently, European network of application servers for analyses and risk monitoring, exchanging data and information on the basis of common standards and rules for exchange and processing and which can work as a super-computer when fed with particularly large amounts of data. It is clear (figure 4), the GRID networks are convenient for solving such a problem [Kussul and Shelestov, 2008].

This can be developed jointly with several DG,s as DG ECHO, DG ENTR, DG JRC, under the Global Monitoring for Environment and Security (GMES) Program [GMES, 2010] and the future realization of Global Earth Observation System of Systems (GEOSS) [GEOSS, 2010].

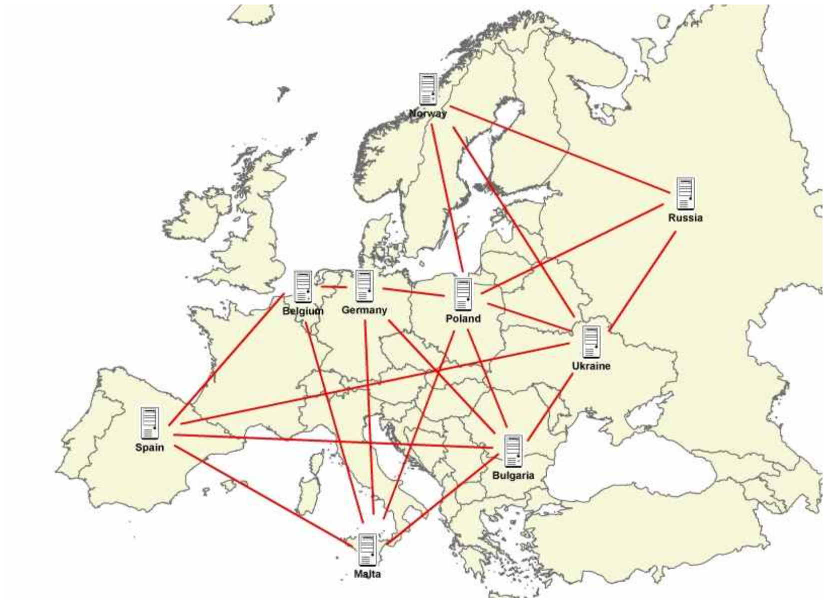

Figure 4. A structure of European network of application servers for analyses and risk monitoring

In close cooperation with the previous network, another regional network is needed to be developed - a network of regional cores (or units) for risk and security management as well as monitoring land cover changes and spatial data quality assurance, and subsequently, a European (or European-Mediterranean) network, also within the framework of the operational application of the GMES and the future GEOSS (Figure 5). The latest concept is very much open to the new tendencies and priorities in the EU 2020 strategy, as well as quality assurance (QA). It will take into account as well, the risk for the citizens, created by the ICT approaches and relevant technologies.

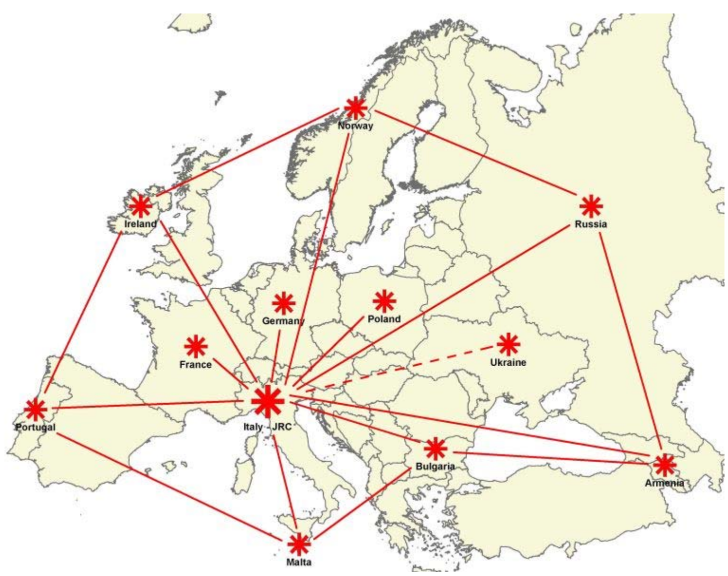

Figure 5. European network of regional units for risk and security management, land cover changes monitoring and data quality assurance

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