EUROPEAN DEFENCE AGENCY

Fact sheet

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Resilience Enhancement of Military Sites through a Continuous Risk Analysis of Regional Critical Infrastructure (REMARC)

Background Description

Nowadays Military Sites (MS)* are tightly embedded in the 'system of systems' (SoS) of critical infrastructure (CI) in a given area; external CI produce services which allow MS to perform their functions. This dependency raises problems related to the continuity of functions that MS must produce, with the further constraint of being provided above a given efficiency threshold. A further complexity comes from the level of internal dependencies among the systems within the SoS: a perturbation of a given CI can propagate also to other CI through cascading effects. Small perturbations could be thus amplified and produce highly non-linear effects whose impact on MS should be predicted and timely solved to avoid critical situations where relevant MS functions cannot be produced.

Although internal supply services (ISS) such as diesel generators, ad hoc communication networks, water and gas reservoirs, can provide limited resources to overcome lack of external services, a more thorough approach should focus on providing the MS of a higher resilience with respect to the reduction (up to the complete loss) of external services. The realisation of this objective goes much beyond the mere increase of the ISS dimensions and requires a more thorough consideration of the different phases of emergency management.

Resilience can be significantly enhanced by acting on all emergency management phases: prediction, prevention, mitigation, recovery. Only acting during all these phases (thus not only after the event but also, and particularly, during 'good times') will ensure an optimal dynamic response of the MS when some perturbation would strike it, either directly and through the reduction of the external services it relies on.

Events prediction is a key issue: predicting means being able to assess their extension and severity and their impacts on services before their occurrence. Prevention will allow triggering appropriate and educated countermeasures to mitigate impacts and to avoid that MS functions could go (although impulsively) below some minimum threshold. Further key issues are represented by the mitigation actions and the strategy (and the efficiency) in the recovery phases. Recovery could highly benefit from the identification of optimal sequences of actions to restore the involved systems by optimising some 'cost function'.

* Note: in this project the term 'military sites' is used to identify fixed infrastructure and buildings inside Europe only.

In the end, the crisis solution being a global problem, it should be tackled coherently and synergically by both the MS and the operators providing external services. All these issues will be considered in the REMARC Project which will deliver a technological tool providing the needed resources for enhancing the systemic resilience of a MS by improving both the prediction and the recovery phases.

Project Analysis

Each MS should deploy an assessment of its level of dependency with respect to external services (electricity, water, gas, telecommunication). This should be done according to specific protocols which can be taken by Smart City concepts (also expressed in ISO/IEC JTC 1[1]).

Once a dependency assessment is provided, a continuous monitoring of the state of risks of regional CI could be performed; it could result in the prediction of natural events (at least those which can be predicted) and in the assessment of the impact (in terms of reduction of one, or more, external services supplied to MS) that the MS will experience. This alerting process will allow the elaboration of educated response strategies which will produce timely, efficient and effective responses.

The tool for continuous monitoring and impact assessment could be shared, furthermore, with external (civilian) operators, in a way to have a constant and coherent synoptic awareness of the external conditions and of their expected impacts on CI, that will be useful to activate coherent restoration and recovery plans. The same tool could also be useful to perform critical scenario building (via the input of synthetic events) to reproduce maximal impact perturbations, which could be useful to shape ISS devices.

Objectives

This project REMARC aims at achieving the following three main objectives:

(1) Identify a procedure (protocol) for the assessment of dependency of MS with respect to external services (limited to electricity, water, gas and telecommunication) to be eventually cast into an EU norm;

(2) Realise a decision support system (DSS) enabling a continuous monitoring of the environmental conditions (in an all-hazard perspective), capable of predicting potential damages induced by adverse natural events on the regional SoS of CI and estimating the resulting impact on services;

(3) Design a new protocol for interaction with external operators with the aim of producing a coordinated emergency strategy for more efficient emergency management and more rapid and effective return to the standard operating conditions (resilience enhancement).

Impact – Expected Outcomes

The first outcome is the enhancement of the capability of MS to react to services outages and to enhance its systemic resilience.

The second outcome will be related to the realisation and the subsequent deployment of a state-of-the-art technological tool enabling a better prediction of the expected events allowing for a ‘deep’ assessment of the expected crisis.

The third outcome will be achieved by sharing such a tool with the external operators. This will allow reacting synergically against the adverse conditions being thus able to adopt coherent mitigation and recovery strategies. This will result in a resilience enhancement and better use of MS resources.

(1) ISO: International Organization for Standardization (ISO), IEC: International Electrotechnical Commission, JTC: Joint Technical Committee.

The simulation capability of the tool (enabling scenario building and assessment) will also be useful for creating a 'critical scenario database' enabling a fast assessment of the emergency strategy to be adopted and a better shaping of the ISS to be deployed by the MS.

Opportunities

Project REMARC will provide twofold opportunities:

(1) provide MS with an intrinsic capability to predict and manage faults of externally-provided services which are at the bases of its functioning and performances;

(2) realise a common technological platform, which could be shared with external operators, enabling to monitor and predict the impact of natural events. This will allow the setup of coordinated strategies (MS and external operators together) which could maximise the impact of the restoration and recovery effect. This aspect is relevant also in terms of a possible strengthening of link and collaboration between a MS and the embedding civilian environment (a city, a district, a region).

Project REMARC, in turn, could leverage on several results from previous EU-funded project (in FP7 and in H2020) allowing the deployment of technological frameworks which have been already designed and realized with previous efforts. This will allow staring from technological products with an already high technology readiness level (TRL) value (namely TRL=6) which can be set to a higher TRL value through an appropriate validation and testing in operational environment and pre-commercial scale.

Challenges

Major challenges will be posed by the following factors:

(a) A reliable DSS for risk analysis and forecast requires the preliminary data acquisition of regional CI, allowing the construction of functional (at the 'functional' scale and not at the 'physical' scale) models of their behaviour upon perturbation. This will require regional CI operator's compliance and their availability to support the project. The resulting outcome (DSS) however, would be of relevance also for the CI operators; an appropriate deal to share the results of the project with CI operators (and the resulting benefits that CI operators could glimpse from its use) could open the way to a collaboration which will allow data acquisition. This is a best practice that has already provided good results in Italy.

(b) The project will have to make collaboration deals with companies or agencies providing reliable environmental data services in the areas. This will be needed as the DSS is triggered by real-time (and near real-time) external data such as weather forecast, nowcasting data, hydrological models, earthquake or other specific geodynamical events which are needed to start the alerting protocol of the DSS and trigger the update of risk maps.

(c) The need of that external compliance (i.e. compliance of many players of the civilian side) rather than being considered as a threat, should be considered as an opportunity of strengthening the relation between the MS and the embedding civilian environment (municipalities, districts, CI operators). This will be done by proposing a win-win deal where, in the face of a sharing of data, there will be a sharing of benefits, produced by the setup and the operational deployment of a regional monitoring and risk forecast systems from which everyone will benefit.

Methodologies

The project idea proposes the following approach:

1. Identification of Dependencies: the first activity will be related to the identification of the key issues needed to perform a complete assessment of the level of dependency of a MS with respect to external services. This would be a transversal requirement which could link REMARC Project to other projects of the same line.

2. Realisation of the DSS: The general workflow of the expected DSS is reported in Figure 1. The database (persistence layer) contains all data (static and dynamic) and the different application boxes will perform specific data analysis and correlation (identification of the type of the predicted event, its localization and strength; definition of the area which will be hit and identify the CI elements possibly damaged; estimate of the impacts on services, also by accounting for systems dependencies, identification of the best restoration strategies).

The DSS will contain several applications as relevant constitutive components. Among them:

(a) an emulator of electrical outages, capable of predicting the spatial and temporal extension of an electrical blackout triggered by the damage of some network element (transformation cabin, cables etc.), also accounting for the telecom dependencies (an electrical blackout could switch off telecom antenna needed for the tele-control operations on the electrical network);

(b) an application to transform a predicted event into the damage of specific assets (like e.g. the estimate of the damage produced by an earthquake or by a severe thunderstorm etc.).

These two applications, for instance, could display a maximal interest for CI operators which, in exchange for such benefits, could decide to share their operational data.

It should be highlighted, however, that the DSS could also be input by 'synthetic' data (rather than by real ones). This will allow its use for scenario building and the execution of stress testing on specific CI (to emulate black swans and producing assessment of worst case scenarios).

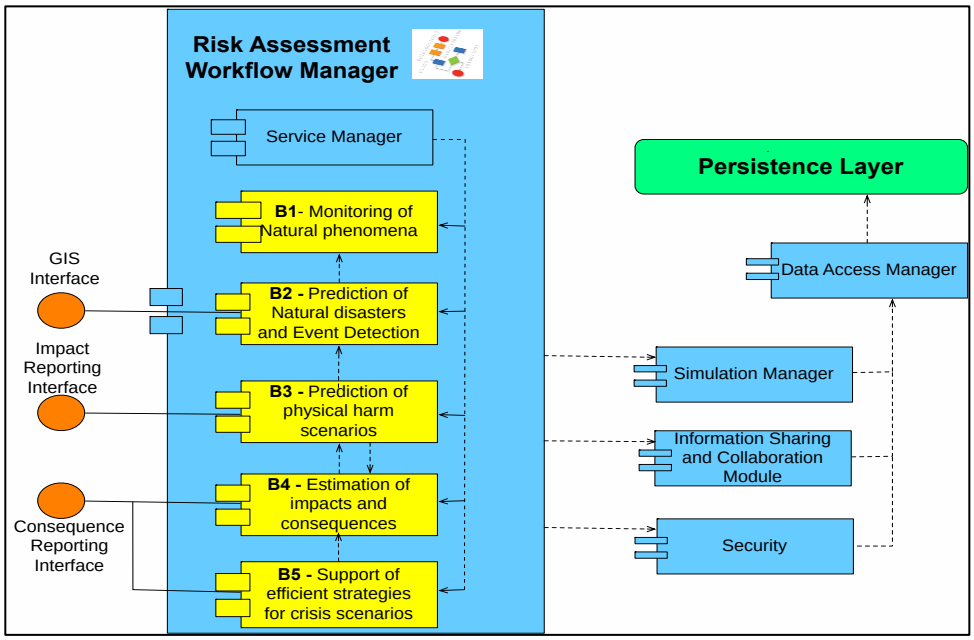

Figure 1. Workflow of the DSS

Way Ahead

The need for building a monitoring 'Control Room' functionality at a regional or even at the city scale is nowadays mandatory. The dependency among CI is so complete that their 'unbundled' protection (i.e. the protection strategy where each CI operator protects its own network without considering, and actually ignoring, the fate of the others) is doomed to failure.

Smartness in a city (or in a district or at a regional scale) can be achieved only by considering these complexity issues (and not by pretending they do not exist). Same smartness and the same holistic view is required by all 'users' of services, such as MS (together with all other large services consumers, LSC, such as plants, hospitals, etc.).

To this end, civilian and military governance of a given area should collaborate to set up a regional risk analysis and forecast capability enabling all different players (CI operators and all types of LSC) to attentively monitor the state of risks of their assets in their areas in order to avoid (or mitigate) large perturbations which might have, on the one hand, repercussion to citizens and, on the other, might produce interruptions (or strong reduction) in the functionality of the defence sector.

This project idea was developed during the second phase of the Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS II) and does not entail any future commitment for the EU Ministries of Defence (MoDs) or the EU institutions or agencies. However, it provides the framework for enabling the formation of multi-national collaborations at the European level to help the MoDs to address common defence energy-related considerations and to move towards a defence decarbonised future. The potential of those ideas will be further explored in the context of the forthcoming CF SEDSS Phase III (2019-2023).

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