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Abstract

This short document presents the final comments and suggestions received by the representatives of end-users in REAKT.

Keywords: strategic applications; capacity building; real-time risk mitigation; end-user liaising

1 Introduction

This short document presents the final comments and suggestions received by the representatives of end-users in REAKT (a mid-term questionnaire compiled by the end-users in summer 2013 is available at :

<http://mercalli.ethz.ch/~cauzzi/questionnaire2013.xlsx>).

At the end of REAKT, end-users were requested to answer the following four questions:

- 1. Does the interest rise already to the level of being ready to implement mitigation actions today?**
- 2. If not, what is needed before you are ready/willing to implement?**
- 3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.**
- 4. What could be improved in a future project to optimise end-user involvement?"**

I collected here all the answers that I received by email either directly from the end-users or from their academic partners. The majority of end-users contributed with critical and informative comments, and share the same outlook depicted by the different WP leaders at the REAKT final meeting. In particular, a strong request to further improve the reliability, understandability and ease of use of real-time risk mitigation methodologies is apparent in the majority of the questionnaires received. This request is accompanied by the awareness that a future project similar to REAKT should mainly focus on implementation cases, while the critical steps of feasibility studies should preferably be addressed within a preparatory phase of the project well in advance of its kick-off. Notable amongst the end-user recommendations are original ideas like e.g. the establishment of a European distributed EEW system (swissnuclear) and the careful scrutiny and definition of legal responsibilities of decision makers (Civil Protection of Italy). Task 7.4b (schools in Campania) and Task 7.6 (IGDAS) are amongst the most successful applications in REAKT, where both the scientific and technical goals of the project were fully achieved as exhaustively presented during the final meeting. The practical indications of interest that we should get from these REAKT case studies are well summarised by their: a) obvious benefits of real-time risk mitigation actions; b) minor or negligible impact of false alarms; c) strong interest of the end-user in collaborating with academic institutions. These elements seem to be key to successful and timely applications of real-time risk mitigation strategies.

Overall, I believe this simple document contains a wealth of important information for the engineering seismology community towards shaping future projects similar to REAKT. This deliverable is public, so that readers outside the REAKT community might profit from reading it before embarking in a similar journey.

Carlo Cauzzi

Randa, 30 December 2014

2 Comments and suggestions from swissnuclear (Task 7.2)

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

No, as the system is not reliable enough for our industry sector.

2. If not, what is needed before you are ready/willing to implement?

Exclusion of false alarms, increased reliability and robustness through maybe inclusion of alternative competing methods in order to have a diversified source of information. Otherwise, we need to believe in the correctness and reliability of a single system/software algorithm.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

➤ Merits:

- The promised and provide tool (User Display) met our expectations and works.
- The discussion with the scientific partners allowed explaining and introducing the complexity of the industrial system, which allowed a better differentiation of the feasible aspects of REAKT
- The participation from our side allowed getting access and knowledge about the latest state-of-the-art in the domain of EEW and OEF which allowed to evaluate if it is ready for application in our industry.
- The project allowed to have a platform where all stakeholders could speak to each other, learn from each other and most important: understand each other.

➤ Deficiencies:

- Cost-benefit analysis doesn't work for certain sectors or is at least to some degree entering an ethic discussion which scientists and engineers cannot resolve
- Inclusion of the end users and engineers for the risk evaluation and technical feasibility of the required features was a bit poor. Scientists can't solve alone the complex practical problem that always requires inclusion of the risk aspect, but they can provide a structured framework in which we can operate.
- The proposed system should work at European level and not be limited to the scale of a single country. This, because the network needs to be large (and not limited to the country borders) and the methods should be harmonized to work together in order to get acceptance in the public.

4. What could be improved in a future project to optimise end-user involvement?

Our end-user involvement was very good. In the aftermath, the end goal and possibilities should have been better explored and discussed at the very beginning of the project. We provided a letter of support, but where only involved some time after the start of the project to discuss what exactly we expect from REAKT and what could be done from the scientific side. In EEW or OEF application the end-user should be involved from the very beginning and express exactly his "wish list" or technical specification, otherwise the risk is to develop something that is not tailored to the customer and thus useless.

3 Comments and suggestions from industrial partner in Sines (Task 7.3)

Below, the Portuguese REAKT Team presents the conclusions drawn from a brief consultation made to the Sines stakeholders, as well as from the meetings held with them during the Project.

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

The general impression we could get showed that a quite significant level of motivation was achieved. The stakeholders risk perception is increasing as well as the interest in knowing prevention measures and good practices to reduce seismic risk in their facilities.

Risk reduction measures were identified both for structures and equipment. Some are “low-cost” measures that can be implemented without a big investment. Operators of the infrastructures showed their interest in these measures and some are already implementing them. The case of improving the base connections of power transformers by clamping or removing the wheels is a good example. As it has little or no cost, it is likely to reduce significantly the risk of this equipment in several facilities.

As far as EEWS is concerned most stakeholders had no information on what can be done with this technology but, once informed, they stated that the implementation of such system would bring benefit to their facilities, avoiding major damage and minimizing propagated effects, in case an earthquake occurs. But others consider that they cannot cope with false alarms, because they can be very expensive and harmful for the functioning of their facilities. And others say that they cannot do much with lead times of 15-25 sec. So these operators are more doubtful on the usefulness of EEWS for their cases.

The overall opinion of Sines stakeholders towards the implementation of an EEWS is quite positive.

2. If not, what is needed before you are ready/willing to implement?

The main problems identified concerning EEWS that will need further research in order to make the implementation of EEWS more useful, thus increasing operators' motivation to participate and even help funding these systems were:

- the need to reduce uncertainties on the lead times;
- the need to increase the reliability of estimations;
- the need to defining the thresholds to trigger the alarms which may depend much on the type of facility/equipment.

Concerning the implementation of risk reduction measures, good and well studied sets of recommendations delivered to the stakeholders, elaborated in simple and clear terms, can make a difference, as they can be a key factor for the awareness raising as well as the willingness of the stakeholders to implement the measures. For the moment, the IST REAKT Team is working in these recommendations and, with the collaboration of stakeholders, they will be used to implement risk reduction measures. Some measures are general, others are stakeholder specific.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

The main merits consisted on the opportunity to study and inform the stakeholders on the potential of earthquake risk mitigation methods, including direct measures to reduce risk and real time systems as EEWS. The main shortcoming was that the project was not long enough to have time to consolidate decisions on the implementation of EEWS. Due to the nature of the problem, it requires more time and effort that was possible within the scope of the project. However, regarding the proposals of direct actions to reduce earthquake risks, it is possible that concrete actions may be enforced, depending on management decisions to be taken.

The whole process implied the direct interaction between the operators of infrastructures and the IST REAKT Team, which was a key factor for the results of REAKT and made this Project innovative from this point of view. In fact, the participation of stakeholders from the very beginning was essential and also allowed learning how to better protect our national critical infrastructures.

It is thought that more interaction with other REAKT partners, especially in the study of the EEWS technical details, would have been useful.

4. What could be improved in a future project to optimise end-user involvement?

In our stakeholders view, the involvement of the operators of infrastructures is essential and very important for the results of the work in order to make them useful.

The Portuguese REAKT Team held several technical visits and meetings with the Sines stakeholders, including individual meetings with each one of them and a general meeting with all of them held in April 9, 2014. A workshop was organised in Sines in October 15-16,2014, not only for Sines operators, but for stakeholders all over the country. Near 100 operators attended.

In a future project, meetings at the European level involving the stakeholders dealing with the EEWS should be organised, in order to improve stakeholders' participation and knowledge, allowing the sharing of experiences

In fact, Sines stakeholders feel this would be very important, because all the contacts they had in the scope of REAKT were mainly at national level, with the players involved.

Since the work of implementing an EEWS was not finished, it is important to take advantage of the awareness and interest the project raised in the stakeholders, to continue the work, namely studying and detailing the ideal requisites of an EEWS for different stakeholders and types of equipment and facilities, improving the scientific aspects and developing a detailed cost benefit evaluation. It is also necessary further work with the stakeholders to implement different measures for the direct reduction of seismic risk.

To conclude, it is obvious that a lot of good, innovative and useful work have been developed in REAKT. The strategic applications were one of the main highlights of the project and the participation of stakeholders was achieved. It gave a contribution to increasing the level of resilience of structures, infrastructures and the population. But it also showed that is still a lot of work to be done and a new REAKT is undoubtedly needed.

4 Comments and suggestions from the Civil Protection of Italy (Task 7.5)

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

The topics dealt with in REAKT were already receiving the attention by the Italian Civil Protection. The REAKT findings have been very useful to check the potentials and limits of OEF and EEW from the scientific and technical point of view. However they do not exhaust the needs for an implementation.

2. If not, what is needed before you are ready/willing to implement?

From a civil protection point of view, implementing mitigation actions based on REAKT acquirements is not a matter of level of interest, which is obviously high. It is rather related to a wider view, in which many further aspects need to be considered. Among these:

- a general acceptance/consensus, from the scientific community, concerning the results which civil protection actions have to rely on;
- an evaluation of the effective capability to undertake civil protection actions following these achievements: which are, if any, the actions really useful to reduce the considered risk? Are they concretely suitable (costs, time needed, applicability to the entire national territory, etc.)? Do they present any contraindications?
- an analysis of, let's say, the downstream part of the process: are local administrators, stakeholders, or even the general public, able to manage the information coming from OEF and EEWs and implement in their turn mitigation actions according to their level and possibilities?
- the definition and test of the procedures which allow the implementation of these mitigation actions;
- a comprehensive campaign of information on what has to be done;
- a clear attribution of the responsibilities.

Without considering at least the aforementioned points, and finding a positive solution for all of them, civil protection organizations in general, and in particular the Italian Department of Civil Protection, are not ready to implement the mitigation actions descending from the REAKT achievements.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

4. What could be improved in a future project to optimise end-user involvement?

From a civil protection point of view, the work done has been deeply appreciated. In our opinion, a further step ahead would be represented by a collaboration between project management and end-user that be envisaged as a solid partnership since the beginning of the activities (i.e., in the submission phase). In this partnership we could design together the whole structure, aims and products of the project, taking advantage from the top-level scientific advancements pursued by the scientific community and, at the same time, orienting this research to more practical applications. This would strongly favour the implementation of large part of the

products at the end of the project, especially on topics such as those addressed by REAKT, and this would represent an added value for a project of risk reduction. As a matter of fact, apart from the OEF and EEWs scientific issues, many other points treated by this kind of projects could be applied in the civil protection field, if set up together. For instance, an interesting work could be done on the entire decisional chain related to the EEWs, which encompasses the evaluation of which practical applications of these methods are more feasible, taking into account the possible actions to be undertaken by the different stakeholders. Moreover, as far as EEW is concerned, considering the results of REAKTS and the typical characteristics of seismicity in European countries, a greater involvement of stakeholders able to perform automatic real time mitigation actions (e.g.: industrial plants, railways and more in general transportation companies, etc.) should be pursued in order to reduce induced risks not only by anticipating a strong earthquake (which appears impossible in epicentral areas), but also by rapid response actions implemented even during the shaking. Specific studies should be carried out for specific applications and well-sounded cost-benefit analyses appear feasible and of great importance for taking decisions. The use of “specialized” local networks that can be directly implemented by the stakeholders should be more deeply explored.

5 Comments and suggestions from Thessaloniki Port Authority and AHEPA hospital (Task 7.7)

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

End users are very interested on REAKT products when it comes to situation awareness. However they are not ready to implement immediate actions in case they do have an EEW and real-time damage assessment.

2. If not, what is needed before you are ready/ willing to implement?

The following are needed before the users are ready to implement:

- Real-time testing of the system for a longer period of time
- Funding to proceed to necessary preparations for immediate actions after an EEW (all end-users in Thessaloniki belong to the public sector)

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

The main merits of the project are the installation of a permanent real-time monitoring network, the development of tools and methods for real-time risk assessment and the application of emergency management strategies to reduce risk for structures/infrastructures of critical interest. Moreover the evaluation of the real vulnerability assessment of critical structures is also of prior importance.

4. What could be improved in a future project to optimize end-user involvement?

After the REAKT project, end users (AHEPA hospital and port authority) are more aware of such projects and its practicalities, thus a more direct involvement from the beginning (preparation phase) should be probably beneficial for a future project.

6 Comments and suggestions from industrial partners in Iceland (Task 7.8)

LANDSNET

As a country that experiences a great deal of seismic activity each year, earthquakes are an important issue for Iceland in general and for its electrical systems in particular. As an end-user my experience is that the work regarding the early warning system has led to some progress that will directly benefit our operations, the details of which I have set out below in the section entitled “Merits of the REAKT approach”.

Regarding the question concerning whether we are ready to implement mitigation actions today, it should be noted that risk assessment and the implementation of mitigating actions are already an ongoing process within the Icelandic national grid and have been taking place for some time.

➤ Merits of the REAKT approach

A benefit from our work with REAKT is an improved understanding of the phenomenon of earthquakes. This has led to improvements in the development of the national electrical system, particularly in relation to where we position high voltage cables since the current demand from the public is that these cables are placed underground.

➤ Deficiencies of the REAKT approach

As an electrical engineer without a background in seismology, I found the material to be rather complicated. Despite that, I managed both to obtain a much deeper understanding of the issues and to develop a good working relationship with the Icelandic Meteorological Office (the “IMO”).

In addition, I expected the system to provide an earlier warning. Nevertheless it is helpful to get a warning as early as possible so that we can respond more quickly to the aftershocks.

➤ Suggested improvements

Following on from the above section detailing the deficiencies, my suggestions for improvements would be to simplify the material and, as far as possible, to provide an earlier warning in the event of an imminent earthquake. In addition, my suggestion is that the meetings are not as long as the final meeting on 1 to 3 December 2014. Many end-users are not familiar with the theory behind the early warning systems and this is what most of the lectures concentrated on. Much of it is rather complex and is difficult to understand, particularly for those of us whose mother tongue is not English. In addition, some of the very eminent lecturers, whose mother tongue is also not English, had accents that were difficult to understand and moved rather quickly through the material which unfortunately resulted in gaps in my comprehension at least of what was useful and very interesting information.

Otherwise, I thank you for the excellent organisation and great learning session.

LANDSVIRKJUN

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

Yes

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

4. What could be improved in a future project to optimise end-user involvement?

The early warning time is short and everything that make the time longer and the EEW more reliable will be pleased.

7 Comments and suggestions from CCEO and UWI (Task 7.9)

CCEO

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

Not quite – the shortage of funding to implement an experimental project with little prospect of early results is an important constraint.

2. If not, what is needed before you are ready/willing to implement?

We have found that as soon as we mention “damage mitigation”, the possible end-users are very attentive, but when we continue to identify the lead time that is available the interest wanes somewhat. We take this to mean that they are not entirely convinced that they would be able to react in the lead-time available. Some of the potential end-users have expressed an ongoing interest in the EEW idea. They include Grantley Adams International Airport in Barbados and the hospital sector in general.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications

Following 2 above, we then tell the end-users about the seismometers and equipment devices that will automatically implement the rapid shutdown processes. However, there is no available definite information to convince them that the seismometers and equipment devices are working realities and that they can be so arranged that they activate the shutdown processes. The sceptics then get involved and convince potential end-users that the EEW is only a theoretical idea. The potential for use in the petrochemical industry in Trinidad & Tobago is significant. It is regrettably that they did not come on board at an earlier stage in the project.

4. What could be improved in a future project to optimise end-user involvement?

We need to be able to take that one critical step forward from theory to reality and we will have an entirely different response. We have not yet gone as far as to have a design of the system and a simple working model for the Eastern Caribbean to show clearly how it would be applied. Such a design would go a very long way in keeping

the enthusiasm alive for, and during, a follow-on project. In a future project we would need to have more in-depth discussions with the hospital sector (through the Pan American Health Organisation) and with the petrochemical industry in Trinidad & Tobago.

UWI

Concerning question 2:

The short lead time, much better in our context than early warning, in the Eastern Caribbean setting hangs critically on distances involved and seismic wave attenuation. Instrumental and human response in activating response is another parameter that would need to be quantified when making the case to convince end users, and silence sceptics. Indeed, quantifying the many variables may allow a clear definition of the threshold distance, below which EEW is not feasible (Of course, this was alluded to, but without a firm definition, in our study). Being able to do this would promote credibility and be possibly more persuasive.

8 Comments and suggestions from Gefyra (Task 7.10)

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

Yes, the interest for implementing an EEW system to the internal procedures for mitigating the earthquake risk is high, nevertheless certain actions should be performed prior the implementation, related mainly with communication of the EEW information, as well as customization/filtering for this particular application.

2. If not, what is needed before you are ready/willing to implement?

The following actions are necessary prior to full application of an EEW system (some of them are partially completed)

1. Comparison of “operational” EEW response map (based on current instrumentation and operation-latency) with existing “known” seismic sources to identify those that are not included to the operational blind zone.
2. Estimation of the intensity parameters on structure site from the aforementioned sources for estimating the potential hazard. In case of insignificant (need to be defined, possibly it is different for structure integrity and user safety) hazard from the remaining sources, the full application is not possible.
3. Evaluation of the EEW system false alerts nature in order to predict rules for eliminating transmission of a false alert (e.g. a number of false alert include epicenters out of area of interest. These alerts can be prohibited from transmission by comparing epicenter with a selected “monitored” area).
4. Instead of comparing the provided (by EEW) event magnitude with the catalog magnitude (in order to specify the accuracy of EEW system) it would be better to compare some estimated intensity parameter at site of interest (e.g. pga or arias intensity) calculated from EEW system first response with the same intensity parameter calculated from the catalog records.
5. Implementation of configurable End user display for a trial/training period

However, only the actions [3] [4] and [5] are necessary for partial implementation of EEW system. The benefits from partial implementation are different in nature from full implementation and are basically related with the response of the technical department and mobilization during an earthquake.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

From our point of view, the active participation of end users is essential for understanding the limitation and effectiveness of every application. REAKT transfers knowledge from the academia to the end user and returns a feedback about the actual needs. This interaction is the real merit of REAKT. Some aspects, necessary for the completion of each WP, would be very helpful if they were foreseen during preparatory phase and before assignment of WP (e.g. user display for EEW WP).

4. What could be improved in a future project to optimise end-user involvement?

It would be very helpful to organize a training program for every possible end user prior to involvement in order to be self - aware of the limitations and benefits from the WP that he is participating. That could provide a quick feedback regarding the efficiency of selected WP to his interest. End users that have convinced themselves for the benefits of the WP would tend to involve more actively. The project could also attribute some manpower to the end-user side, this would allow a stronger participation, instead of just relying on the Academia partner.

9 Comments and suggestions from ITIS Majorana (Task 7.4b)

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

Yes. Further, we think that the EEW system in use at ITIS Majorana can be immediately implemented in other schools.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

Merits: There is a great interest in applying EEW to schools as soon as possible. The pilot study carried out at ITIS Majorana has helped us in identifying deficiencies of our current safety plan.

Deficiencies: End-users were made aware a bit late about the implementation plan. I would recommend a closer involvement since the beginning of the project. Furthermore, students should study seismic risk topics during afternoon activities.

4. What could be improved in a future project to optimise end-user involvement?

Increase end-user involvement through dissemination and outreach activities, education activities with experts, and support in developing teaching activities at school, including software development.

10 Comments and suggestions from IGDAS Istanbul Natural Gas Distribution Company (Task 7.6)

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

IGDAS has already implemented mitigation actions using EEW signal. The company is interested to improve the mitigation strategy with cooperation of academia in national and international levels.

2. If not, what is needed before you are ready/ willing to implement?

Cooperation with universities and research centres are necessary for the further works to improve the risk mitigation activities.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

The REAKT project provided a gathering of EEW end users. The opportunity of sharing different risk mitigation strategies in international level was also another merit of REAKT project. Interaction with other components of EEW provided better understanding of whole process of EEW.

It is not deficiency but it would be good if REAKT project can be an initiative for the EEW users to arrange yearly workshops, to develop codes and improve risk mitigation strategies.

4. What could be improved in a future project to optimize end-user involvement?

The awareness of EEW can be increased by explaining the EEW operations in detail and subsequent risk mitigation actions with sample cases.

11 Comments and suggestions from FSM Bridge Istanbul (Task 7.11)

1. Does the interest rise already to the level of being ready to implement mitigation actions today?

KGM (General Directorate of Highways) has an interest on mitigation actions. The critical viaducts in two main motorways have been retrofitted recently. Two suspension bridges which link the city's European and Asian sides are monitored by KGM and KOERI. Currently, these works are done mainly in Istanbul and Marmara region. It should be done in nationwide.

2. If not, what is needed before you are ready/ willing to implement?

There is a need of guideline for the further mitigation actions for the highways and viaducts. The international collaboration and projects such as REAKT is good to develop mitigation actions.

3. Based on your experience in the project so far, please list the main merits and deficiencies of the REAKT approach to the strategic applications.

The main merit was the involvement mitigation actions from different infrastructures. The experience of different EEW users provide good knowledge on how the mitigation action can be improved. The cooperation with academia and introduction of new implementations worldwide were the benefits as KGM we benefit from REAKT project. We would like to continue this cooperation in future which will make available the interaction with international users, academia and keep us update in mitigation actions worldwide.

4. What could be improved in a future project to optimize end-user involvement?

If a deliverable of Development of guidelines for each specific infrastructure is considered in future projects, this would attract the end-user of that specific infrastructure to be involved in the project.