DESTRIERO – A DECISION SUPPORT TOOL FOR IMPROVED RECONSTRUCTION, RECOVERY AND INTEROPERABILITY

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1 INTRODUCTION

Imagine an immensely complex, million-piece puzzle on a huge table, which was created through years of hard work. Now imagine a tornado that ravages mercilessly through the table, damaging, misplacing and mixing pieces. There are multiple actors that want to help rebuild the puzzle – yet there are problems. First, some pieces are still under duress. They need to be saved and protected. Second, pieces differ greatly between each other. Some are huge, some are small, some need a one-off intervention, some need to be taken care of in the long term as well, some are much more important to the puzzle than the others. Some puzzles cannot be fitted back if another piece has not been placed correctly beforehand. Third, the actors that want to help in rebuilding the puzzle, are very different. Some are fitted better to lift and manage big puzzles, but are useless in finding and addressing the needs of the smallest of them. Actors are also not that great in communicating with each other, which stems redundancy of some efforts and misallocation of resources. Some pieces will be left stranded because of that, and some actors will try to accomplish tasks way too big for their capabilities and the other way around, as well. If you want the puzzle to be back soon, things need to change.

2 PROJECT BACKGROUND – CRISIS AND DISASTER MANAGEMENT

Ascent of human kind has been derailed multiple times throughout history by natural or human caused disasters. Earthquakes, volcanic eruptions, tsunamis, fires, extreme weather conditions and many more have always been an enormous threat to civilization. Today, despite continuous technological advances, we are still very vulnerable to catastrophes of such kind – and we added potentially many more threatening factors by creating weaponry of immense power and by affecting the climatic balance of the planet. Also, the rapid growth of human population and its localization in very dangerous areas susceptible to floods and earthquakes add to

already high risk of extreme catastrophes impacting and threatening lives of millions[1]. Complicated industrial chains are also prone to being broken with tragic consequences to regional economies, further affecting the entirety of the population. No protection and prevention is currently strong enough for the decision makers not to worry about large-scale catastrophes and no contingency planning is clairvoyant enough to predict every twist possible in the future crisis situation, and the response to this situation must anyway be swift, combining flawless execution, efficiency and cost management if possible.

Today the industrialized, capital-rich countries are rather resilient to crises and effective in dealing with consequences of catastrophes, but there is a significant room for improvement – every life lost is a sign of the system malfunction. There are operational procedures and protocols of disaster management – designated national-emergency bodies usually take care of basic planning and coordination[2]. They perform assessment of top priority humanitarian needs of the affected population. Those national institutions are however not the only ones that take part in the relief effort – it is the foreign and non-governmental organizations that sometimes provide bulk of the help in some areas, which creates potential problems in coordination, resource allocation, reconstruction and recovery. Countries do have to accept help from those actors, since usually a catastrophe big in scope outmatches the national relief capabilities, and possibly damages more than one country territory. Crisis management processes have not escaped the touch of globalization – the vision of co-dependent mankind, technological developments and the creation of organizational catalysts for cooperation on supra-national scale in multiple areas lead to the rapidly growing possibility of multiple actors working in unison to achieve a common humanitarian goal. Even such developments as social media may have an impact on the engagement levels from other countries in helping the afflicted areas, as the pressure to send help can be a strong sentiment in the societies that are informed about a humanitarian situation and/or relief efforts. Also, globalization and industrialization processes lead to the growing co-dependence of countries that do not even have to be geographically close to each other, and even the particular interests of the country economy may dictate the enhanced cooperation measures in bringing back the harmed industries to life. Some of the new threats are also much more border-ignorant in their scope, as some natural and manmade catastrophes do not stop at a border of a particular country, with pollutions and contaminations being a prime example of such a contingency.

Therefore in many instances the humanitarian response and restitution of the area to the state close to the pre-disaster is a joint effort with multiple international actors involved – ranging from militaries (national and organization-led, such as EU or UN), civil responders, volunteers, state agencies to nongovernmental/international organizations (i.e. International Red Cross) and others. Those actors have different organizational structures, different goals, different resources, communication tools, data management standards and other differing local specifications – with sometimes the most glaring one being a different language spoken[3]. The status quo is not satisfactory – most of the joint decisions are made on physical meetings, which require the actors to be present at the same location which is obviously impractical given the critical nature of the circumstances. Apart from those meetings and occasional radio/telephone contact the different organizations act relatively autonomously, without continuous coordination, neither collaborative, nor top-down. Even the meetings that are “digitalized” and occur through the internet, take at best forms of teleconferences via Skype, GoToMeeting or similar software which does not allow for fluid data transfer and graphical interfaces to be shown. Therefore there is no commonly used advanced platform-type software to support *joint* decision making and *joint* operation, in which the information would be continuously updated and presented to the users.

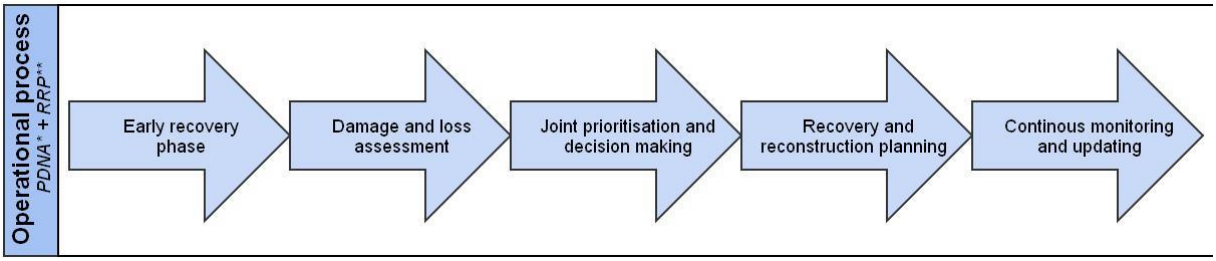

Figure 1 Operational process in the context of DESTRIERO (*- Post Disaster Needs Assessment, **- Recovery and Reconstruction Planning)

A typical relief operation consists of stages (Figure 1), as the process of governing catastrophes has to be split into what happens before the relief action, during and after them. Preparedness to response is not an explicit part of this project, as it is limited in scope to gathering baseline information crucial for building up resilience, but reconceptualization of the other two stages is of key importance to the DESTRIERO team and the objectives set before the project. Always, the first priority in response during and post-catastrophe management will be the humanitarian effort to secure lives and health of maximum number of inhabitants of the inflicted area. Affected citizens are to be rapidly secured by any means possible and no expenses should be spared in this effort. Efficient tactics and strategies need to be established and need to be as flexible as possible. Data collection is of vital importance here, as defining who needs what help where is a decision that can potentially save lives if correct. Data regarding the situation, especially humanitarian situation, has to be constantly updated and analyzed for both the operation leaders and the responders on the ground to know exactly what they are dealing with and what conditions the responders will have to withstand and what challenges they will face. This data also pertains the concerns of the local population, and has to outline their needs, capacities and resources possessed and moreover, needs to take into consideration the state of the local infrastructure and general socio-economic conditions in a given location. Every aspect of the relief stages presented above should be interoperable to the fullest possible (desired) extent, so that every important user gets the full operational context of the actions, partaken both jointly by many actors of individually. Single access point to the relevant data should be enabled.

To effectively manage the incoming data and all of the other conflicting issues and potential problems with the harmony of the relief effort a joint software platform would be a perfect tool. However, this is simply not the case as of right now – no advanced tools can provide sufficient management capabilities for the whole palette of disaster threats and for all the possible actors in the relief effort. No coordination is possible without quality information [4], however. Lack of an information platform that can be updated in real time, shared between any actors through multiple channels, from handheld devices to operations centers, lack of adequate recovery progress monitoring tools and recovery benchmarking systems is extremely dangerous.

3 UNDERLYING ARCHITECTURE OF DESTRIERO[1]

This is the palette of needs that DESTRIERO responds to. It will be a state of the art damage and post-crisis assessment tool for reconstruction and recovery coordination and planning. Its net-centric structure will enhance its management potential and will enable multiple actors to fully contribute their relief potential to the recovery operation. In the following article the basic architecture of DESTRIERO will be presented and it

[1] DESTRIERO - A DEcision Support Tool for Reconstruction and recovery and for the IntEroperability of international Relief units in case Of complex crises situations, including CBRN contamination risks

will be demonstrated how it responds innovatively to the ever-more threatening challenges that stand in before crisis management institutions today. Crisis situation creating a need for a rapid, organized response for civil services will be always present in our world. Multiple innovative solutions built into DESTRIERO will help make those responses quicker and better organized. DESTRIERO's architecture (Figure 2) will support continuous damage and contamination assessment, monitoring and updating, with data coming in from different integrated sources.

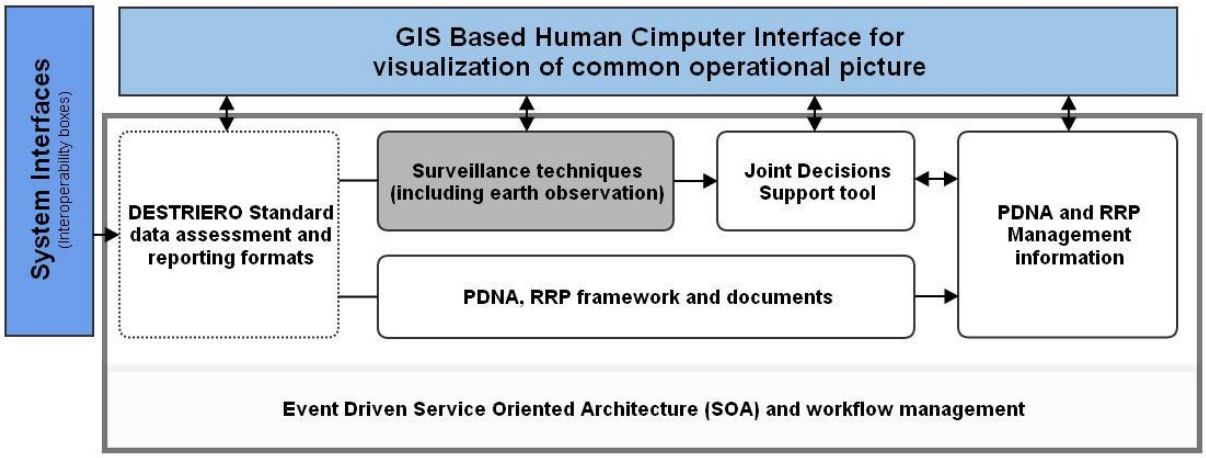

Figure 2 DESTRIERO building blocks and software suite

The data that will come into the system will be easily shared between different actors in the relief process. Data will be visualized to create an enhanced, immersive operational picture. Visualized data allows for a better and smarter decision making and prioritization, both key factors in the success of the relief operation. Finally, management of information will be centralized, paradoxically allowing for some organized decentralization in the process on the ground. On top of the data and the recovery priorities set up by the decision makers, an evaluation model will be applied – the MYRIAD[2] [6]. It will provide the users with graphical and textual explanations of the data, such as evaluation of the data, asset analysis, potential flaws in the solution and will generate recommendations based on input data. It will be fully integrated into the DESTRIERO toolbox, therefore helping prioritization in the decision making process in real time without managing two tools at the same time.

4 DESTRIERO GOALS

DESTRIERO aims to alleviate the harms current situation by introducing a platform that is designed to fulfill four main, overarching objectives, in accordance to the key internationally agreed methodologies, procedures and standards. The goals have been crafted with the end-users best interest in mind – it is fundamental to provide an understanding and an overview of the collaborative working needs of national and international relief units during recovery and reconstruction.

- Faster and better damage assessment for planning and monitoring of progress of recovery. DESTRIERO will integrate different data sources like satellite data, aerial photos and mobile devices inputs into a coherent information management tool. It will enable the users to access important data in real time.
- Facilitate fast and intuitive access for distributed users to visualize the dynamic "common operational picture", during the planning and reconstruction period.

[2] MYRIAD - multi-criteria decision analysis tool and methodology from THALES Research and Technology.

A state of the art visualization technique will enable the users both on the field access to view data, including damage reports, pictures and remote control data in real time during the on-going recovery phase.

- Better collaborative decision making during the planning and reconstruction phase by increasing the interoperability of different information systems from the stakeholders and standardizing data both leading to better prioritization, resource allocation and joint decision making.
- Improve management information in relation to PDNA and RRP. An access point and a library with PDNA and RRP frameworks will be provided to increase overview levels. Accountability of humanitarian agencies and inconsistencies will be increased through higher accountability.

The above goals do reflect a realistic approach to what can be done with a current state of the art technology to improve the efficiency and success of the processes in relief operations. They do also respond to needs and requirements that have been thoroughly identified as valid and urgent by sector specific end users. Several innovations will have to be implemented to achieve the goals outlined here, as represented in the next chapter. DESTRIERO will enable the end users to access a lot of information through a single comprehensive system. All of the information that will be included into the system is relevant to the relief process. The data can be some or all of the following, which management the system enables:

- The “humanitarian dashboard” (humanitarian data centre and current/future needs assessment)
- Situational overview with data on organizations taking part in the emergency operation
- Documents regarding joint decisions by actors
- Progress reports
- Administrative information
- Mapping of the PDNA and RRP processes
- Relevant maps of the area, highlighting critical infrastructures
- Remote sensing data about CBRN contamination

All of the points above reflect specific spaces in which coordination between relief units should happen and is needed. This coordination helps to align parallel activity streams, such as coordinating mechanisms, assessments, strategic planning and funding mechanisms in time, order and space. Inside the activity streams stakeholders must be organized to ensure effective allocation of limited resources, avoid both effort duplication and gaps. Moreover, key issues for data management have been identified in humanitarian effort coordination and they will be treated as a basic layer of system requirements: standardization, capacity building (technological and human) and information availability. All those factors together will contribute to the improvement in information management between actors.

5 METHODS USED IN DESTRIERO

One of the staples of DESTRIERO design is using multitude of complimentary methods to improve on the current status of disaster relief interoperability and hastening the responses. While some tools may use one or two of those methods, it is their juxtaposition that creates the synergic effect that we expect to induce. Therefore, DESTRIERO will use state of the art technologies to achieve its desired goals,

including several prototype tools developed by the consortium partners[5], using their experience in other research projects and by adapting some existing solutions. Due to the nature of the project, key innovations will be integrated into the scheme in the following areas:

I. Data collection in surveillance for PDNA and RRP
   a. Earth observation and aerial imagery data - Integration of satellite data and aerial remote sensing capabilities as a key technology will be a vital part of DESTRIERO surveillance assisting module. Georeferenced to standard map projections, incoming data can be integrated into different systems, like GPS position, on field sensor data and other mobile assets. Using those tools will allow the decision makers and responders alike to access data such as the extent of affected areas and the extent of damages.
   b. On-field visual inspection - A complementary method of damage analysis will be accessible for the system operators, as data from this source will be adaptable as well. It will be an extension of the SMS technology by SAADIAN. Multiple platforms (e.g. iOS, Android, BB, Symbian, Windows) will be fit for information exchange.
   c. Sensing, remote sensing and CBRN data collection - Information about the CBRN contamination will be available thanks to geo-spatial tools, providing relevant information about the location and the scale of the disaster, with dynamic dispersion and situation prediction tools.

II. Improving presentation of information - Multi-layer GIS information visualization
   Experiences from multiple FP6 and FP7 projects, that many of the consortium partners have, will be used to facilitate construction of a integrated web based data access points through a WebGIS View application and on field through mobile devices.

III. Joint-decision making - Multi-criteria decision-aiding tool
   A multi-criteria decision support tool, called MYRIAD and developed by THALES Research and Technology will be used in DESTRIERO and integrated fully as a part of the Decision Support System.

IV. Interoperability of services - Event Driven Service-Oriented Architecture
   Combining event-driven solutions with service oriented architectures inherits features of both - the web services address the interoperability issues in systems, and event driven systems enable asynchronous interactions.

Those innovative solutions and their novel combinations will lead to DESTRIERO being an improvement over the current state of the art in disaster relief management. Those main, basic methods are not all of them – for example, DESTRIERO will use the DaLA (Damage and Loss Assessment) Methodology to assess the magnitude of the damage, losses taken and secondary effects of the event. It has been developed in the 1970s by the Economic Commission for Latin America (ECLAC) to provide basic guidelines for damage evaluation. DaLA, in combination with PDNA (alas, the accepted standards by EU, UN and other international organizations involved in needs assessment), will be built upon to create improved capabilities for relief efforts and operational interoperability will be increased. Each of the methods will be complimentary with the others to create a synergic effect, for example merging multiple data inputs from different data gathering sources will create a much better understanding of the

environment that the operation is taking place in and allow this data to be accessed remotely through a multitude of platforms and by many actors at the same time.

6 CONCLUSIONS

Dangerous disasters are going nowhere – they are here to stay for as long as humankind is alive. The better we can manage those crises, the faster we can repair the damages caused by humans or by nature, the better our lives will be. Post-catastrophe operations are getting better and more sophisticated every year due to improving technology and better predictions. However, we see relief operations and their characteristics as still lacking and in need of improvement. The DESTRIERO project will assemble key innovations into a comprehensive disaster relief assistance package, which aims at alleviating some of the gravest threats to the post-catastrophe operations and respond to some of the most glaring needs by the involved end users. Adequately coordinated needs assessment, reconstruction and recovery planning can contribute significantly to mitigate the humanitarian and economic impact of crisis situations and speed up the restoration of the area to the status quo ante. The importance of key dependencies between different actors and their methods of collaboration (and improving on these methods) are all the highlights of DESTRIERO. It is their cooperation that ultimately decides on the efficiency of the relief operation and it is an area of concern as of now, due to severe fragmentation and lack of interoperability by the actors in the operation. Coordinated assessment of post-disaster needs and sharing of vital data, identifying cross-cutting needs related to recovery capacities are going to be significantly improved as a result of the DESTRIERO's progress beyond current state of the art. The effects will be, depending on the observers perspective, either unspectacular, or stunning. We choose to believe the latter - that if our system contributes to any number, however small, of lives saved, livestock spared from the disaster, possessions preserved, homes rebuilt even marginally faster and assistance delivered just a bit quicker, DESTRIERO has fulfilled its end goal – and it has great potential to do so.

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