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SEISMIC RESILIENCY IS THE FUTURE OF SMART CITIES: EXAMPLE DUBAI

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ABSTRACT

Natural and induced seismicity negatively impact urban environments. If the future of humanity relies on the collective benefits of urban density then the objective of this presentation is to demonstrate how seismic resiliency paves the way for smart cities. In the event of a disaster, advances in seismic technology now enable smart city stakeholders to react better to large-scale business interruptions, manage operational continuity of critical infrastructures, and most importantly ensure the community that there is a sound plan to move forward. Tall buildings, especially in emerging economies, sustain large financial loss and reputation damage from unnecessary evacuations and downtime due to large but non-damaging earthquakes. Case-studies, including the Burj Khalifa of Dubai, are used to illustrate different employments of high-end instrumentation, performance-based engineering services, emergency response planning, and novel technology-based communication channels to achieve rapid well-informed decision making and critical information dissemination.

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Seismic Resiliency is the Future of Smart Cities
Example Dubai

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Introduction

Natural and induced seismicity negatively impact urban environments. In the event of a disaster, advances in seismic technology now enable smart city stakeholders to react better to large-scale business interruptions, manage operational continuity of critical infrastructures, and most importantly ensure the community that there is a sound plan to move forward.

United Arab Emirates may have low seismic hazard, but the Gulf community still incurs negative impact due to earthquakes [1]. The issue comes from widespread over-reaction to long-duration shaking from seismic waves emanating from Iran-Pakistan sources. This has been observed in the mass unnecessary evacuations in 2013 and again, more recently November 2017. The solution to avoiding costly and potentially dangerous over-reaction is enabling better-prepared occupants and better-informed decision makers [2, 3].

The objective of this extended abstract is to raise awareness of this issue and demonstrate a solution being advanced by the Dubai Municipality.

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A Business Continuity Case for Earthquakes

In April 2013, two large earthquakes struck the region of southern Iran. ShakeMaps® created by USGS for the two earthquake are shown in Fig 1. Although nearly 1000 kilometers away and producing relatively low amplitudes of structural response, both events resulted in mass evacuations across several Gulf countries including the UAE, Fig 2.

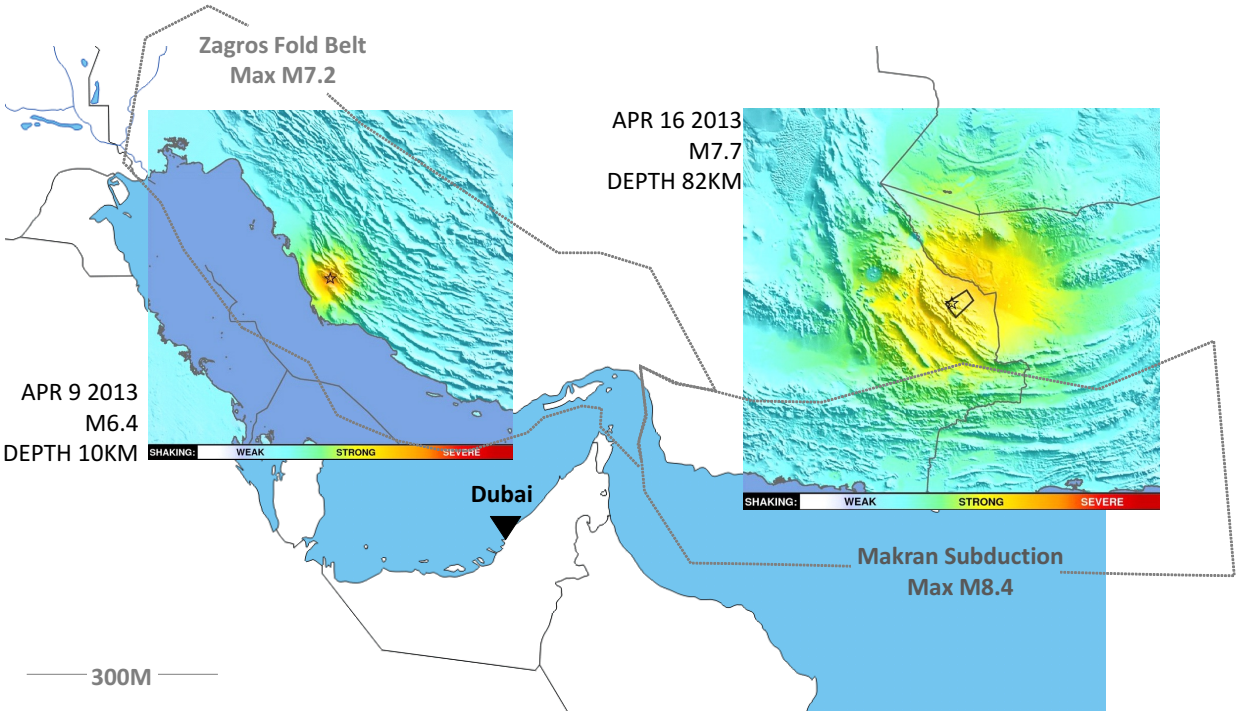

Figure 1. Gulf region showing seismic hazard sources with April 2013 USGS ShakeMaps®.

Figure 2. Photos of unnecessary evacuations (Source: Emirates 24|7 News, UAE National and DaijiWorld).

OasisPlus is an end-to-end solution based on high-end instrumentation, performance-based engineering services, and novel technology-based communication platform to achieve rapid well-informed decision making and critical information dissemination. It consists of four main parts:

1. **Monitoring technology** refers to high-end instrumentation that continuously monitors important building response parameters such as interstory-drift that indicate structural performance. It provides data that answers the question: *how much did my building move?*

2. **An alarm system** provides intuitive alerting on exceedance of multi-level demand parameters that come from a detailed seismic evaluation of the building structural and non-structural systems (using ASCE-41, for example). Along with the monitoring, the alarm system effectively converts data into actionable information. It answers the question: *how much is too much or could there be a safety concern?*

3. **A rapid post-event assessment program** (such as REAP® [3] based on ATC-20) provides the highly-customized onsite procedures for rapid safety assessment of the building. It instills preparation and confidence in the facility operators leading to quicker and more confident decision making. It answers questions on severity such as: *do we need to evacuate?*

4. **A centralized communication platform** is the final component for greater situational awareness, streamlined decision making, and information dissemination. Complimentary to conventional public announcements and red/yellow/green tagging, OasisPlus introduces web control and mobile notifications to help manage evacuation/re-entry decision making and process. It facilitates two-way communication between occupants and crisis management allowing for instant check-ins, hazard reporting, post-event checklist gathering, etc.

Since 2006, the Dubai Municipality has lead the way with seismic resiliency projects and promoting public awareness [2]. Recently, several tall and critical buildings have been outfitted with a Dubai branded version of OasisPlus called DB-Safe, Figs 3-4.

Figure 3. Selected buildings instrumented under the Dubai Municipality Smart Building project.

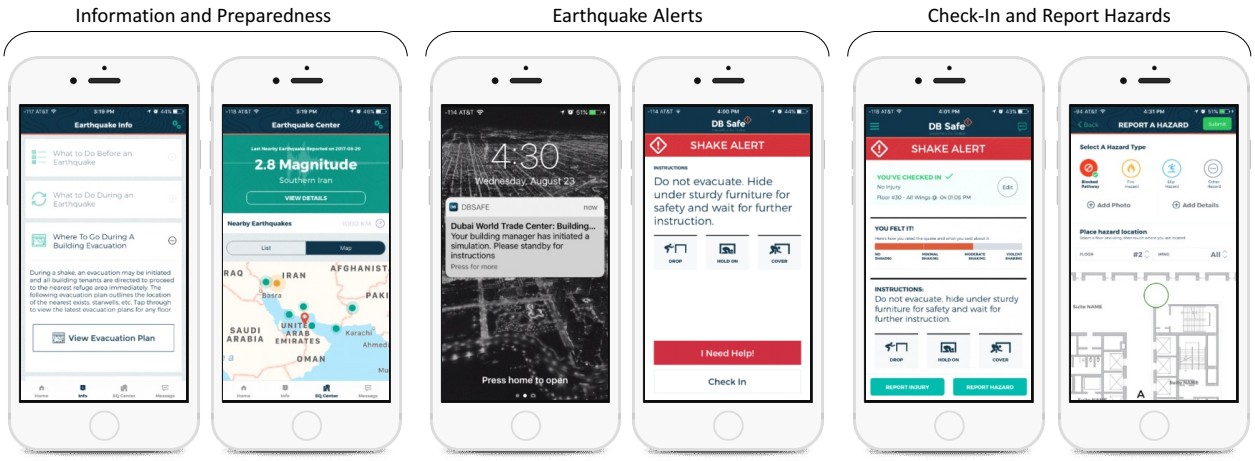

Figure 4. OasisPlus mobile application screens for information dissemination before, during and after earthquake

Conclusions

In UAE April 2013, we observed unnecessary mass evacuations, distressed crowds without proper guidance, and ill-equipped building managers ultimately leading to significant economic loss from business disruption and downtime.

Business continuity comes from better-informed decision making and effective information dissemination. OasisPlus is the solution to avoiding costly and potentially dangerous over-reaction by enabling better-prepared occupants and better-informed decision makers. It consists of four main components; ***Monitoring Technology*** for real-time measuring of building movement, an ***Alarm System*** for intuitive alerting on exceedance of performance-based movement thresholds, a ***Safety Assessment Plan*** for rapid post-earthquake onsite safety inspections, and a ***Centralized Communication Platform*** for greater situational awareness, streamlined decision making, and information dissemination.

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