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China Builds System that can Predict Earthquakes 'Three Weeks in Advance'

As reported by Neil Connor, a reporter from "The Telegraph", Chinese scientists have been able to develop a system that can predict earthquakes up to 3 weeks in advance (Connor, 2018).

Currently China uses an EEW (Early Earthquake Warning) system that covers up to 650 million people that represents almost half of the country population and is able to issue a warning slightly over a minute before the earthquake. For example, last year (2017)this system was able to warn via mobile phone inhabitants of Chengdu (capital of Sichuan) 71 seconds before the start of the earthquake. (Durden, 2018)

Scientific research has found that early warning system can save lives and reduce destructions. "Being aware of an earthquake 3 seconds ahead can save 14 percent of casualties, 10 seconds can save 39 percent of casualties, and 20 seconds can save 63 percent of casualties" (Xinhua, 2018).

They estimated that 71 seconds warning might have saved the life from 20 thousand to 30 thousand people. (Jianqiang, 2018).

This old system was working by detecting P-waves (waves emitted before earthquake arrival) that arrive short before the S-waves (waves that create the earthquake).

The new technology allows its sensors to scan the earth to a much deeper extent than previous technologies. It works through a "cloud image" system based on sensory technology that has the same effect as X-rays or CT scanners generating an image of the seismic activities in real time (Xiaoci, 2018). According to Dr. Wong Tun, the lead scientist of the project, the new warning system will monitor, thanks to detectors buried under the earth surface, the "stress and energy dynamics" from 8 up to 20km (4 to 12 miles) underground. Dr. Tun also believes that the two systems (the old one that measures P and S-waves, and the new one that measures stress and energy dynamics) will be able to work together. The new system is not very precise but will be able to identify well in advance the rough location and timing of the earthquake. Then it will be up to the old system to find the exact location and timing, but this information will be obtained only one minute before the earthquake.
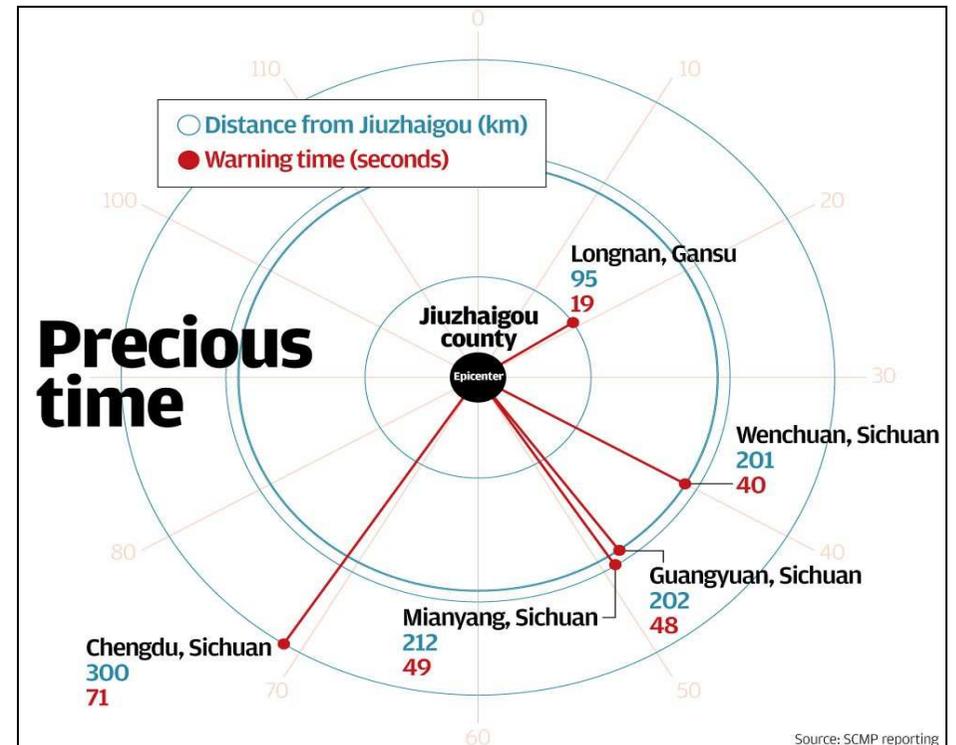

Fig. 1 Distance and warning time during   2017Sichuan earthquake

For the old system, Fig.1 shows the distance in km (in blue), and the warning time in second (in red) (for example Chengdu that was at a

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distance of 300 km from the epicentre of the earthquake was warned 71 seconds before arrival of the earthquake).

This new technology is able to anticipate earthquakes with a magnitude higher than 5.0 (Connor, 2018). Generally, earthquakes with a magnitude of less than 5.0 provoke only minor damages, and sometimes not even felt.

According to Global Times, using this new "sensory technology" should become as easy as reading a meteorological cloud image (Xiaoci, 2018).
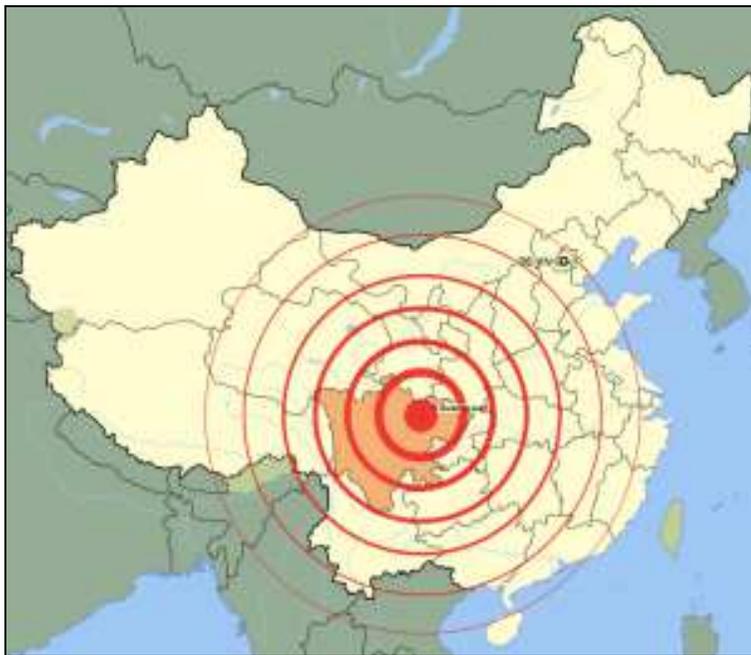

Fig. 2 Map showing the epicentre of the 2008 Sichuan earthquake.

This new technology will be first implemented in Sichuan and Yunnan. These are regions that history showed to be the most likely to be hit by

earthquakes. The first monitoring station was installed at the beginning of May 2018 in Wenchuan, Sichuan province.

This area (Fig. 2) was the epicentre of the 7.9 magnitude earthquake that killed over 80,000 people in 2008 (Eli, 2018). By the end of 2019, 2000 more underground monitoring systems stations will be installed in these two provinces. Nowadays, due to modern technology there has been an incredible step forward in the "Earthquake prevention science". With further steps forward, in the future it might be possible to predict with extreme accuracy any earthquake and subsequently may save countless lives.

La Cina crea un Sistema di Allerta Sismico in grado di predire con tre settimane di anticipo un Terremoto

Come riportato da Neil Connor, giornalista del "The Telegraph" degli scienziati cinesi sono stati capaci di creare un sistema di allerta sismico in grado di predire un terremoto con tre settimane d'anticipo (Connor,2018).

Al momento la Cina sta utilizzando un sistema chiamato "EEW" (Early Earthquake Warning, ovvero avvertimento precoce di terremoti) in grado di "proteggere" fino a 650 milioni di persone, circa la metà del paese, e riesce ad avvertire la popolazione poco più di un minuto prima dell'inizio del terremoto.

Per esempio l'anno scorso (2017) gli abitanti della città di Chengdu (capoluogo della regione Sichuan) sono stati avvertiti tramite segnalazioni su *smartphone* esattamente 71 secondi prima dell'inizio del sisma (Durden, 2018).

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Varie ricerche scientifiche hanno dimostrato che il sistema EEW riesce a salvare numerose vite e a ridurre il numero di edifici distrutti. Essere al corrente di un terremoto con 3 secondi d'anticipo può ridurre il 14% di vittime, 10 secondi possono ridurre il 39%, e 20 secondi possono ridurre fino al 63%. (Xinhua, 2018). È stato stimato che i 71 secondi di preavviso abbiano salvato tra le 20 mila e le 30 mila persone (Jianqiang, 2018).

Questo vecchio sistema funziona individuando le onde P (onde emesse poco prima dell'arrivo di un terremoto) che precedono a loro volta le onde S (che creano il terremoto).

Il nuovo sistema di allerta sismico permetterà di scannerizzare più a fondo del sistema precedente il suolo terrestre. Questo sistema funziona tramite un processo"*cloud image*" che lavora tramite una tecnologia basata su sensori che hanno un effetto simile ai raggi X o uno CT scanner generando un'immagine in tempo reale (Xiaoci, 2018).

Secondo lo scienziato a capo di questo progetto, Dr. Wong Tun, il nuovo sistema di allerta sismico, grazie a dei rilevatori sepolti sotto la superficie della terra riuscirà a monitorare "*stress and energy dynamics*" da 8 fino 20km in profondità. Dr. Tun sostiene inoltre che i due sistemi (quello vecchio che individua le onde P e S, e quello che monitora i "*stress and energy dynamics*") riescano a funzionare contemporaneamente.

Il nuovo sistema non è molto preciso ma è in grado di ipotizzare una data e una posizione approssimativa del terremoto con tre settimane d'anticipo, poi sarà il sistema EEW che dovrà trovare la posizione e il momento esatto del terremoto, però queste informazioni saranno ottenute solo qualche secondo prima del sisma.
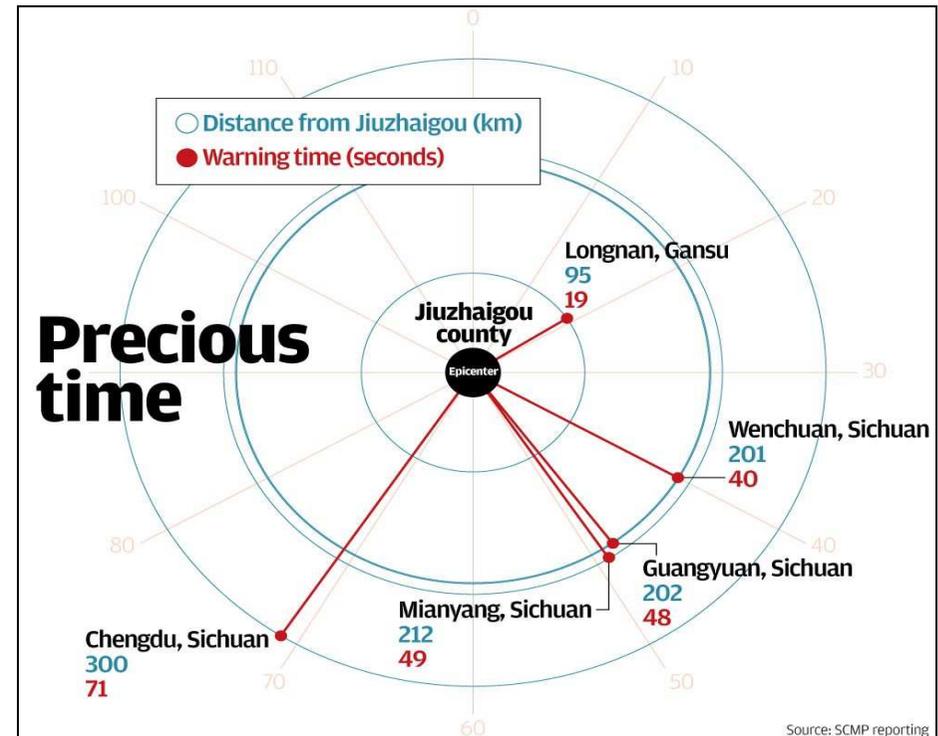

Fig. 1 Distanza e tempo d'avvertimento durante il terremoto a Sichuan nel 2017.

Nella Fig.1 viene mostrata la distanza percorsa in km (in blu) e i secondi di allerta (in rosso) per il sistema EEW (per esempio Chengdu era a una distanza di 300km dall'ipocentro del terremoto e sono stati avvertiti 71 secondi prima dell'arrivo del terremoto).

Il nuovo sistema di allerta sismico è capace ad anticipare terremoti con magnitudine superiore al 5.0 (Connor, 2018). Generalmente terremoti con magnitudine inferiore a 5.0 provocano solo danni minori, e a volte non li si percepisce nemmeno.

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Il Global Times riporta che questa nuova "tecnologia a sensori" dovrebbe risultare semplice quanto interpretare immagini meteorologiche (Xiaci, 2018).

Fig. 2 Immagine che mostra l'ipocentro del terremoto a Sichuan nel 2008.

Questa nuova tecnologia sarà implementata per prima nello Sichuan e nello Yunnan perché queste regioni sono da sempre state soggette a terremoti. La prima stazione di monitoraggio è stata costruita all'inizio di maggio 2018 a Wenchuan, nella provincia di Sichuan. Quest'area (Fig.2) è stata l'ipocentro del terremoto con magnitudine di 7.9 che nel 2008 ha ucciso 80.000 persone (Eli, 2018). È in programma per la fine del 2019 la creazione di altre 2.000 stazioni di monitoraggio sotterranee che verranno costruite nelle stesse provincie.

Oggigiorno, grazie alla tecnologia moderna, ci sono stati dei progressi sostanziali nel settore delle prevenzioni di terremoti. Con ulteriori progressi in futuro, forse, sarà possibile predire eventi sismici con estrema precisione e si riuscirà a salvare molte più vite.
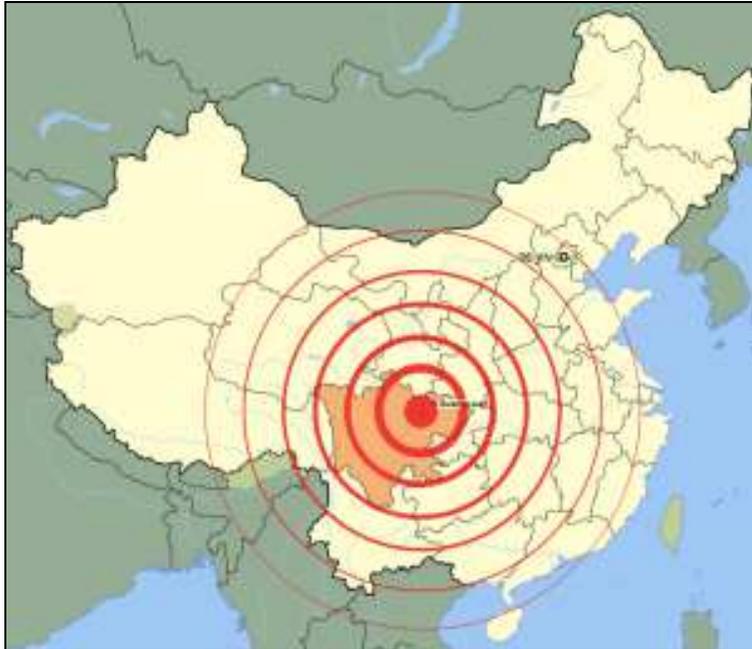
Italy: "Industria 4.0"

In February 2017, the Italian government launched an Industrial Plan called "Industria 4.0" in order to boost foreign direct investments in emerging sectors such as startups and technology. This will provide a significant boost to Italy's economic growth and development after more than a decade of both economic recession and zero growth. Furthermore, this will increase Italy's competitive advantage in a digitalized world, as it currently lags behind in digital innovation as compared to other EU and non EU countries.

Industry 4.0 is defined as "…the current trend of automation and data exchange in manufacturing technologies" This was first implemented in Germany as 'Industrie 4.0', it was an "action plan sponsored at a federal level with the involvement of large technological and industrial players" and was later adopted by France as 'Industrie de Fur' and USA as 'Manufacturing USA'. In an ever more digitalized world, it is vital for countries to incentivize technological and industrial firms in order to be able to compete globally.

As of 2016, a large majority of foreign firms and companies with foreign shareholders (aprox. 6,500) present in Italy are based in the region of Lombardia [Lombardy]. The region of Lombardia offers a vast

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amount of resources and opportunities for both domestic and international firms to expand and invest in current and future manufacturing processes. Furthermore, the region is already at the forefront in innovative research and is considered the powerhouse of Italy, as it offers well-established manufacturing, financial infrastructures, and an ample skilled workforce.

According to an article published by the Italian embassy of London to promote "Industria 4.0"; The nine technology drivers of "Industria 4.0" are:

1. **Advanced Manufacturing Solutions**
   a. Autonomous, cooperating industrial robots. *Numerous integrated sensors and standardized interfaces*

2. **Additive Manufacturing**
   a. *3D printing, particularly for spare parts and prototypes. Decentralized 3D facilities to reduce transport distances and inventory*

3. **Augmented Reality**
   a. *Augmented reality for maintenance, logistics, and all kinds of SOP. Display of supporting information, e.g. through glass.*

4. **Simulation**
   a. *Simulation of value networks. Optimization based on real-time data from intelligent systems*

5. **Horizontal/ Vertical integration**
   a. *Cross-company data integration based on data transfers standards. Precondition for a fully automated value chain (from supplier to customer, from management to shop floor)*

6. **Industrial Internet**
   a. *Network of machines and products. Multi-directional communication between networked objects*

7. **Cloud**
   a. *Management of huge data volumes in open systems. Real-time communication fr production systems*

8. **Cyber-security**
   a. *Operation in networks and open systems. High-level of networking between intelligent machines, products, and systems.*

9. **Big Data and Analytics**
   a. *Full evaluation of available data (e.g. from ERP, SCM, MES, CRM, and machine data) Real-time decision-making support and optimization.*

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Included in the 'Industria 4.0' are major key industry tax incentives that the government has implemented in order to attract both FDI and domestic investment in the technological and start-up industry. These include:

1. **Hyper and Super Depreciation:**
   a. *This provides an opportunity for firms to investment in new assets (software and IT). Hyper-depreciation provides a 250% amortization rate for investments in 4.0 Industry's. Super-depreciati*on provides a one-year extension of a flat rate of 140% on all investments.

2. **Credit to Innovation (New Sabatini Law):**
   a. *A 30% tax deduction for investments up to 1 million euros in start-ups and SMEs*.

3. **R&D tax credit:**
   a. *A tax credit of 50% for R&D investments between 2017 and 2020.*

4. **Patent Box:**
   a. *A 50% deduction on the net revenue derived from intangible property, which includes patents, trademarks, industrial designs, and copyright software.*

5. **Tax deduction on investments in innovative start-ups:**
   a. *A 30% tax deduction on investments in venture capitals.*

The main 5 key benefits that will result from 'Industria 4.0' include flexibility, speed, productivity, quality, and product competitiveness. The government expects that high levels of flexibility will allow firms to achieve greater levels of economies of scale through mass production. The incentive plans highlighted by the government will facilitate and speed the process between the prototype stage and mass production, this in turn will lead to an increase productivity due to lower down-times. By utilizing advanced sensors and innovative technologies, companies will be able to increase their product/service quality. Lastly, higher competitiveness of products due to the additional functionalities enabled by the Internet of Things will allow firms to compete in an international environment.

China Monitors Environmental Changes from Space

The China has become the world's No. 1 carbon dioxide emitter as rapidly progresses towards becoming the No. 1 global powerhouse.

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Although, economic growth and development have significantly increased the standard of living for a Chinese citizen, rising air pollution levels have resulted in 1.6 million deaths per year. As a result, in the recent years, President Xi Jinping has prioritized and taken great leaps forward in order to combat rising pollution levels and reduce greenhouse emissions; especially in major cities such as Beijing and Shanghai. As of 2017, China has successfully established itself asa world leader in tackling global climate change by utilizing present and emerging renewable energy technologies in order to reduce the country's dependency on fossil fuel. Furthermore, the reduction in CO2 emissions China has demonstrated that economic growth can be maintained without sacrificing the environment.

On May 9th 2018, China launched the Gaofen-5 rocket, which contained a hyperspectral imaging satellite utilized to monitor environmental changes that range from resource exploration to monitoring air pollution movements. The satellite and technology was produce and designed by China Aerospace Science and Technology Corporation, the satellite was designed to have a life-span of 8 years.

Gaofen-5 is China's first satellite that can monitor air pollution, furthermore, it can "…dynamically reflect the state of air pollution in China through the monitoring of air pollutants, greenhouse gases, aerosols.". Additionally, the Gaofen-5 is the world's first full-spectrum hyperspectral satellite for observation of the atmosphere and land. The satellite is equipped with a total of 6 advanced observation payloads, which varies from a shortwave infrared hyperspectral camera and a greenhouse detector. The Chinese government hopes that the Gaofen-5 will significantly reduce China's dependence on foreign hyperspectral satellite data.

According to Wang Qiao (Ministry of Ecology and Environment), said "the satellite can detect inland water, land surface environment and altered minerals, providing reliable data for China's environmental monitoring, resource exploration, and disaster prevention and mitigation". The satellite will significantly improve China's ability to analyze the composition of air pollution systems and facilitate the government's efforts to reduce air pollution. Furthermore, it will allow the government to localize the origin of the emitted pollution and subsequently track its progress to nearby cities.

On the 4thof June China launched the Gaofen-6, a hyperspectral satellite which has a similar function to the first satellite launched, Gaofen-1. The satellite is equipped with high-resolution cameras that will monitor crop yield, deforestation, and the progress of agricultural projects. Furthermore, it will monitor the effects of agricultural disasters, such as floods and droughts. The Gaofen-6 will form a constellation with the other Gaofen satellites that are currently in orbit around the world, this will provide a holistic view of both land and air movements in China.

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