

Allianz Global Corporate & Specialty

Megacities

Pushing the Boundaries of our Industry

Risk trends and insurance challenges



Allianz 

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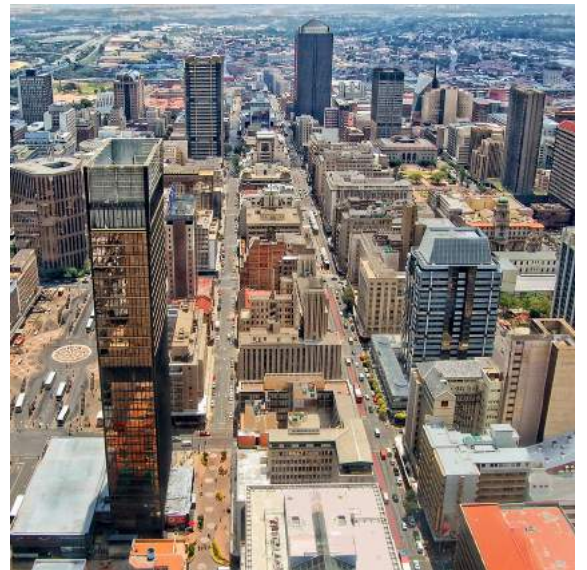
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Introduction

A recent Allianz publication: **The megacity state: The world's biggest cities shaping our future** received widespread recognition. The document gives an insight into how human livelihood will evolve over the next 15 years and touches upon the challenges in risk and insurance, which society will face. In accordance with the United Nations (UN), Allianz defines megacities as urban areas exceeding 10 million inhabitants and describes them as highly interconnected, dynamic and vibrant centers, which will over time contribute higher income and living standards for their citizens.¹

The growth number for megacities is impressive. A 2006 UN working paper documented that there were only two megacities in 1950, Tokyo and New York City (NYC). The number increased marginally in the following quarter century to three in 1975, Tokyo, NYC and Mexico City. In contrast, the next 25 years saw a dramatic growth to 18 megacities in 2000. Since then, the digital age has reinforced the pull factor exerted by the megacity and makes it increasingly difficult for demographic experts and governments to extrapolate, forecast and steer the growth. In this respect, the above mentioned 2006 UN working paper predicted 22 megacities in 2015, while in



Left: Tokyo

Above: Johannesburg

¹ Allianz: The megacity state: The world's biggest cities shaping our future.

reality the last year recorded 29 megacities – a good 30% above the UN forecast.²

Megacities in their enormous size accumulate impressive physical, human and intellectual resources, they increase economies of scale and lower production costs.

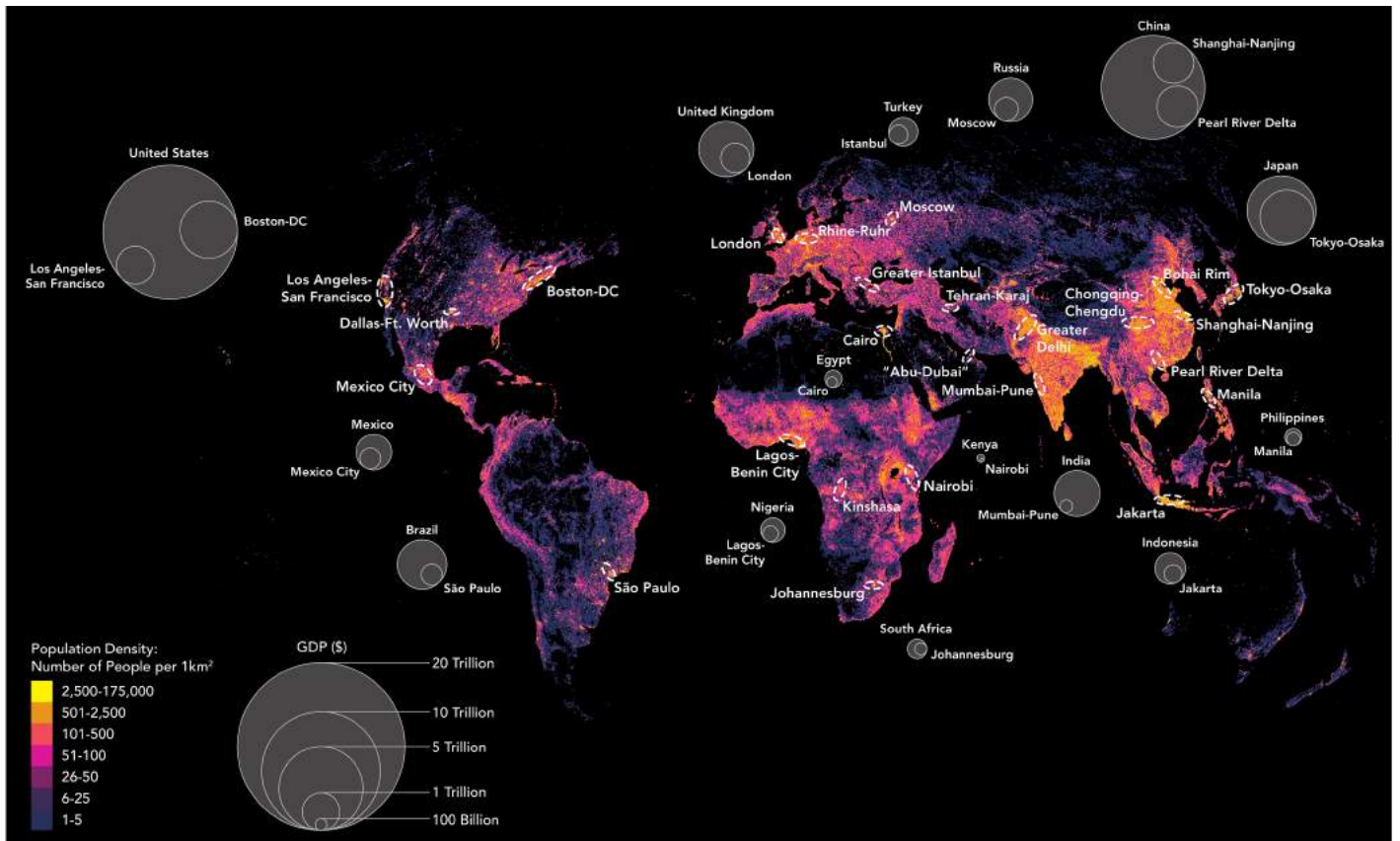
A McKinsey study on the megacity’s attractiveness for business foresaw in 2012 that in future years the economic compound annual growth rate (CAGR) of the top 20 megacities will be as high as 7.6%. As such, the cities would outpace the rest of the global economy by almost twice and account for \$5.8trn of global gross domestic product (GDP) by 2025.³

Research by the World Economic Forum (WEF) verifies McKinsey’s thesis by creating a unique visual (see below) which “...took the entire world’s population and plotted it by density, and [...] superimposed the largest urban

archipelagos, the megacities, [...] vis-à-vis the national economy.” As a result, the mapping exercise illustrates that global GDP is much more dependent upon the largest megacities than it is on the world’s 200 sovereign nations. For example, Japan heavily relies on the economic power house Tokyo, and to a smaller extent on Osaka. In South Africa, Johannesburg and Pretoria represent in excess of 35% of the country’s GDP. It is “... the same logic in Lagos — there is practically no Nigeria without Lagos. It applies to Sao Paulo in Brazil, Jakarta in Indonesia, Moscow in Russia, Istanbul in Turkey...”⁴, the WEF concludes.

Evidently, megacities matter today and will do so even more tomorrow. Taking the above mentioned Allianz publication as foundation, this paper intends to examine more deeply the implied challenges, which megacities bring to the insurance industry, and seeks potential solutions to those challenges.

Megacities’ economic power in relation to countries’ GDP



Source: World Economic Forum (1), 2016.

² United Nations Department of Economic and Social Affairs, Population Division, 2006. P.2. And: Allianz: The megacity state: The world’s biggest cities shaping our future. P.12.

³ McKinsey Global Institute, 2012. P.5. ⁴ World Economic Forum (1), 2016.

Focus on Asian Megacities

As of today, 16 Asian megacities represent the majority of the global total number of 29 (*see below*). The nature of Asia's megacities and their "maturity" mirror the cultural, ethnic and economic diversity of the entire region.

Low-maturity Asian megacities are defined in terms of high growth rates, youthful population, social inequality and lack of infrastructure, which is for example witnessed in Karachi, Manila, Jakarta or the Indian representatives Delhi, Bangalore, Kolkata, and Mumbai.⁵

On the other side of the spectrum are Tokyo and Osaka as high-maturity megacities, which are characterized by high wealth, modern and innovative infrastructure and an aging population. The Chinese representatives Shanghai, Shenzhen and Beijing are described as medium-mature with slowing growth rates, a developing middle class and an existing but still fragile public transport system, leading to congestion and air pollution.⁶

Not only for their diversity but even more for their growth potential, Asian megacities need to be given special attention. A census in 2010 documented that Asia's

Demographic indicators of the world's 29 megacities.

Megacity	Country	2015 population in millions	2030 population in millions	2030 population growth	2010 population age distribution (%)			2010 population density per km ²	2015-2020 average annual population growth rate (%)
					0-14	15-64	65+		
Tokyo	Japan	38.00	37.19	(- 0.81)	12	69	19	4,400	0.17
Delhi	India	25.70	36.06	(10.36)	25	71	4	12,100	2.65
Shanghai	China	23.74	30.75	(7.01)	9	80	11	6,100	2.67
São Paulo	Brazil	21.07	23.44	(2.37)	22	71	7	7,500	0.98
Mumbai	India	21.04	27.80	(6.76)	22	72	6	32,400	1.64
Mexico City	Mexico	21.00	23.86	(2.86)	25	68	7	9,700	0.81
Beijing	China	20.38	27.71	(7.33)	9	80	11	5,500	3.43
Osaka	Japan	20.24	19.98	(-0.26)	13	67	20	5,400	0.28
Cairo	Egypt	18.77	24.50	(5.73)	26	69	5	8,900	1.83
New York-Newark	US	18.59	19.89	(1.3)	19	68	13	1,800	0.21
Dhaka	Bangladesh	17.60	27.37	(9.77)	30	65	5	43,500	3.52
Karachi	Pakistan	16.62	24.84	(8.22)	37	60	3	23,400	2.92
Buenos Aires	Argentina	15.18	16.96	(1.78)	23	65	12	5,300	0.92
Kolkata	India	14.86	19.09	(4.23)	26	69	5	12,200	1.13
Istanbul	Turkey	14.16	16.69	(2.53)	24	70	6	9,800	1.28
Chongqing	China	13.33	17.38	(4.05)	15	72	13	7,700	2.67
Lagos	Nigeria	13.12	24.24	(11.12)	32	65	3	14,500	4.17
Manila	Philippines	12.95	16.76	(3.81)	31	66	3	15,300	1.48
Rio de Janeiro	Brazil	12.90	14.17	(1.27)	21	70	9	5,800	0.65
Guangzhou	China	12.46	17.57	(5.11)	11	82	7	6,000	3.94
Los Angeles	US	12.31	13.26	(0.95)	21	68	11	2,400	0.23
Moscow	Russia	12.17	12.20	(0.03)	12	74	14	3,500	0.50
Kinshasa	DRC	11.59	20.00	(8.41)	46	51	3	19,900	3.95
Tianjin	China	11.21	14.66	(3.45)	11	78	11	5,400	2.68
Paris	France	10.84	11.80	(0.96)	20	68	12	3,800	0.77
Shenzhen	China	10.75	12.67	(1.92)	8	91	1	6,900	0.98
Jakarta	Indonesia	10.32	13.81	(3.49)	24	73	3	9,500	1.81
London	UK	10.31	11.46	(1.15)	18	68	14	5,900	1.01
Bangalore	India	10.09	14.76	(4.67)	23	73	4	8,400	3.20

Source: Allianz: The megacity state: The world's biggest cities shaping our future. P.12.

⁵ On the low maturity of Indian megacities versus China's managed urbanization programs, see: Dobbs, 2010.

⁶ Allianz: The megacity state: The world's biggest cities shaping our future. P.8 and P.12.

population was still largely rural. The region's urbanization ranking was second from the bottom with 42% – only slightly ahead of Africa's 40%. Historically, Western nations had led global urbanization and were instrumental to the fact that the world population became predominantly urban in 2008. In the future, however, Asia and – naturally – Asian megacities will lead the development. Within the current decade, 60% of the growth in the world's urban population will be generated in Asia or – in real numbers – a total of 411 million people will be added to Asian cities, according to UN Habitat.⁷

Beyond the megacity, researchers and urban planners are envisioning the concept of the **gigacity** – a super-conurbation approaching 50 million and more inhabitants. Not surprisingly literature refers to Asia, which hosts already the top-3 megacities with Tokyo (37 million), Delhi (26 million) and Shanghai (24 million), as the region where such gigacity developments could be realized.⁸



Shanghai



Delhi

⁷ UN Habitat, 2010. P.6. ⁸ Cox, 2014, and China Daily, 2014.



The Thames River Barriers, London

Natural Catastrophes

Earthquakes, cyclones and flooding are the most relevant natural catastrophe (NatCat) perils threatening megacities. While earthquakes hitting major urban areas, especially in Japan (Kumamoto 2016, Miyagi 2011, Kobe 1995, Tokyo 1923) and the United States (Los Angeles 1994, San Francisco 1906), are ever present through their shocking images and well-documented in their impact, flooding threatens the livelihood of significantly more people than earthquake or any other NatCat peril.⁹

From ancient times urbanization has developed along major waterways and in coastal areas. Water has been the key for the emergence and success of the megacity, and poses at the same time an eternal threat to it. Just as for cyclones, the magnitude of flood related NatCat events is exacerbated in recent decades by the effects of global warming.

The London Thames Barriers exemplify how important it has become for megacities to brace themselves against flooding in times of climate change. As a response to recurring major floods, most notably those of 1924 and 1953, the English capital started operating the massive flood defenses in 1982.

Londoners in general and particularly those employed in the banking center Canary Wharf have a lot to thank

the masterminds who engineered and constructed the mini-piers and silver pods that span the eastern gateway. By shutting, the Thames Barriers have secured the city more than 120 times since 1982. Alarmingly, under the influence of global warming more than 60 closures fall in the years since 2010.¹⁰

Zooming in on Asia and comparing it to other continents, NatCat research documents that the region hosts – with little exception – the world’s riskiest cities, located especially in Japan, China, Taiwan, Indonesia, and the Philippines. Many Asian megacities appear in the top-10 global rankings, leading the charts not only in terms of people endangered but also GDP at risk. Even more, cities like Tokyo, Jakarta, Manila, Mumbai and Shanghai are facing a broad mix of perils.¹¹

While NYC, Paris or London have achieved their megacity status through growth over centuries, the enormous speed of urbanization displayed in Asia leaves city developers in low- and middle-maturity megacities without the time and means to develop appropriate NatCat protection and business continuity plans for the case that disaster strikes.

In 2013, a World Bank study on flood related losses predicted a potential increase to \$1trn by 2050 from

⁹ SwissRe, 2014. P. 12. ¹⁰ The Guardian, 2015. ¹¹ SwissRe, 2014. P.35ff.

\$6bn in 2005 if the growing threat is not efficiently countered. The World Bank names Asian coastal megacities as being most affected.¹² In an interview, economist Stephane Hallegatte estimates that on average coastal cities will need to spend approximately \$400m annually on flood defense measures and names insurance and transnational cooperation as key factors to avoid or mitigate disaster.¹³

Hallegatte's reference to insurance is rightly made in light of Asia expanding its number of megacities. A review by Aon Benfield of the 2015 top-10 economic losses inflicted by NatCat shows that underinsurance or low insurance penetration still prevails in Asia. In 2015, five of the top-10 events occurred in Asia. While the region suffered more than 90% of fatalities and almost 70% of economic losses, insurance recoveries flowing into Asia accounted to less than 15%.¹⁴ This picture, however, will change rapidly and dramatically as prosperity and insurance penetration for Asian low- and medium-mature megacities increases.

Businesses in megacities will continuously seek enhanced protection for their increasing values at risk. For companies and their property insurers, NatCat exposures will materialize inside of megacities through Property Damage (PD) to assets, for example, factories, and connected Business Interruption (BI) as well as Contingent Business Interruption (CBI), which will be triggered under suppliers and customers extensions. Supply chain dependencies create a systemic risk in the global economy. They are difficult to measure

since often losses are incurred hundreds or thousands of kilometers away from where the NatCat strikes.¹⁵ Accordingly, commercial and corporate insurers need to give special thought to CBI related dependencies in order to guarantee a sustainable offering to property clients. A consultative approach and dialogue between insurers and insureds is needed to fully understand and gauge the exposure – especially in the context of NatCat affecting business in a megacity.

Outside of property insurance, life and health insurers are threatened by NatCat events incurring in major settlements. The rise of the middle class and the “emerging consumer”¹⁶ in Asian megacities will lead to a higher take-up of life, annuity and pension coverage. Insurers are challenged to model the impact of NatCat on policyholders in an explosively growing megacity.

How the insurance industry can collaborate and contribute to the prosperity and recovery once a NatCat has struck is illustrated by the events following the 2011 Thai floods, which affected households in Bangkok and major business parks in its suburbs. The flood took the insurance industry by surprise. Its impact was unforeseen since it was unmodeled in the NatCat departments of the region's and the world's leading insurers and reinsurers. In the aftermath of the event, which caused \$43bn of economic and \$16bn of insured losses¹⁷, the insurance industry and the Thai government cooperated closely to ensure speedy claims payments to those most in need. Confidence building measures and presentations by the government, for example, about effective water

NatCat Losses 2015 – underlining low insurance penetration in Asia.

Date(s)	Event	Location	Deaths	Economic Loss (USD)	Insured Loss (USD)
Yearlong	Forest Fire	Indonesia	19	16.1bn	250m
April 25 & May 12	Earthquake(s)	Nepal	9,120	8bn	200m
October 1-11	Flooding	United States	21	5bn	700m
October 2-4	Tropical Cyclone	China, Philippines	22	4.2bn	100m
Nov-Dec	Flooding	India, Sri Lanka	386	4bn	650m
May 23-28	Severe Weather	United States	32	3.8bn	1.4bn
February 16-22	Winter Weather	United States	30	3.3bn	2.1bn
August 2-9	Tropical Cyclone	China, Taiwan	34	3.2bn	100m
December 26-30	Severe Weather	United States	46	3bn	1.3bn
December 22-31	Flooding	United Kingdom	N/A	2.5bn	1.3bn
			All Other Events	70bn	27bn
			Totals	123.1bn	35.1bn

Source: AonBenfield, 2016. P.2.

¹² The World Bank, 2013. ¹³ Hallegatte, 2013. ¹⁴ AonBenfield, 2016. P.2. Latest reports from Sri Lanka's flood losses again underline the notion of severe underinsurance in Asian emerging countries. See: Asia Insurance Review, 2016 (May 23). ¹⁵ PWC, 2015. P.15. ¹⁶ On the concept of the “emerging consumer”, see: EY 2014. P. 5ff. ¹⁷ Schanz & Wang, 2015. P.15.

management via dams, water-retention areas, flood barriers at industrial zones etc., were attended, welcomed and rewarded by Thai and non-Thai insurers alike through continued commitment.¹⁸ Similar to a public private partnership (PPP), a government-backed flood pool was created to alleviate the situation and provide capacity to business.¹⁹ Originally thought to be a short term instrument, the pool has continued to exist over the last five years as a symbol of risk sharing between government and the private insurance industry. Even though limits are small, the pool has benefitted especially local small and medium enterprises (SMEs) which could not afford the price or leverage bulk buying power to obtain flood coverage from the insurance market.

The degree of self-criticism displayed by the insurance industry after the flood was striking. The Insurance Journal, for instance, quoted a senior insurance practitioner who conceded that "...the event was not a

'Black Swan' – the industry simply never paid sufficient attention to potential flood risk – we were simply fooled by historical experience..."²⁰. More importantly, following the self-criticism determined actions were taken to move RMS, AIR or Eqecat, the leading vendors, to create NatCat models appropriately geared towards Asia's growing markets and megacities.

In summary: realistically NatCat, such as earthquake and flood, will continue to be a major threat to Asian megacities. In particular, the impact of flood is dependent on a number of parameters, such as human judgment at times of crisis and global warming effects, and will never be fully mitigated.²¹ However, the experience accumulated over decades, the improved modeling capabilities and especially the successful collaboration between the insurance industry and governments give reason for optimism to megacities, their citizens and businesses.



Bangkok flood in 2011

Photo: Voice of America, via Wikimedia Commons

¹⁸ The Nation, 2012. ¹⁹ Bangkok Post, 2011. ²⁰ Insurance Journal, 2012. ²¹ On the difficulties of insuring flood exposures in Asia, see: Schanz & Wang, 2015. P.23ff.

Pandemics

A recent study by the Commission on a Global Health Risk Framework for the Future (GHRF Commission) states:

“A range of factors, including increasing population, economic globalization, environmental degradation, and ever-increasing human interaction across the globe, are changing the dynamics of infectious diseases. As a consequence, we should anticipate a growing frequency of infectious disease threats to global security.”

The study continues to describe the impact of a pandemic event to be catastrophic in terms of lives, livelihoods and economic costs. The estimated, annualized loss is to exceed more than \$60bn, according to the GHRF Commission.²²

Population density, economic dependency, environmental pollution as well as human interaction – including regional and trans-regional mobility and logistics – as key factors and breeding ground for

pandemics present themselves in an aggregated format in the context of the megacity. Subsequently, throughout history the leading cities of their time have been afflicted over and over again by infectious diseases like the plague in Rome (166 AD), Paris (1348) and London (1665-1666).

In the last decade, matured megacities outside of Asia proved their robustness to pandemics in 2009 when the metropolitan governments of NYC and Mexico City effectively countered the outbreak of the “swine flu” or in medical terms influenza A (H1N1). With 20 million inhabitants each, NYC and Mexico City belonged at the time of the outbreak to the top tier of the global megacities. While both cities benefitted from a widespread city landscape, strong political leadership, an extensive public communications campaign, and advance planning, which had procured sufficient medical and sanitary resources, were key to contain the disease within a few pockets.²³ A 2009 research paper examining the measures taken against swine flu found

²² GHRF Commission, 2016. P.V and P.2f. ²³ Chowell et al, 2011, and Farley, 2009.



grounds for confidence in the case of NYC and Mexico City, but pointed to the potential weakness of lower income cities to combat pandemics:

“Of the 27 megacities, 16 will be in Asia [...]. [Megacities...] are increasing in developing countries and often have slums that lack basic services. The accelerating global trend toward megacities is a new paradigm of human existence and poses profound public health challenges. New approaches for surveillance, preparedness, and response will be needed because current strategies may not be easily scalable upward to address huge, densely populated areas, especially in developing countries.”²⁴

The vulnerability of Asia’s megacities documented itself earlier in 2003 through the spread of the Severe Acute Respiratory Syndrome, an extreme form of pneumonia abbreviated as SARS. Within a short time span, the SARS virus, which originated in mainland China, was transmitted via air travel from Hong Kong to numerous Asian megacities like Beijing, Tianjin and Shenzhen and other major cities like Hanoi and Singapore.²⁵ Thirteen years after SARS, medium-mature megacities in Greater China may be better prepared for the outbreak of infectious diseases. However, low-maturity megacities like India’s Mumbai and Delhi or Bangladesh’s Dhaka with an estimated 20-30% of city housing located in poorly sanitized slums²⁶ will still be primary victims of pandemics.

In the area of life, health and benefit insurance, the above outlined impact of a pandemic on a megacity requires actuaries and modelers to work with new scenarios. Those models need to address the reality that larger concentrations of people place more people at risk of exposure to infectious diseases. Especially in megacities with a smaller footprint like Hong Kong, whose nature is more vertical than horizontal, the risk of spread is increased due to high concentrations of residents in more confined space. Compared to rural or smaller city settings, in a megacity immense health care costs will be associated with a single event and potentially affect life and health insurers in a time of low investment rates and continuous market softness.

Technical advancement might bring some relief to life and health insurers as well as authorities, who concern

themselves with gauging and limiting the impact of infectious diseases on a megacity population. Newly developed 3D printing techniques could offer solutions to swiftly build mass-housing facilities in times of crisis and move citizens out of infested areas.²⁷

Regarding property insurance, the nature of infectious diseases in comparison to NatCat events is strikingly ambivalent. On the one hand, the pandemic spread is invisible, gradual and with limited impact on assets, whereas the force of nature strikes with high visibility and suddenness. On the other hand, the impact of both risks is very similar when it comes to supply-chain interdependency – in technical terms, CBI related losses.

Branded as non-physical damage, pandemics can cause large claims to property insurers under the coverage extension “denial of access” or “infectious disease”. Megacities do not only hold important manufacturing sites, but also the headquarters of a country’s leading companies, national stock exchanges, data-centers etc. Following the outbreak of an infectious disease, denial of access to a metropolitan business center, like Makati, Manila’s central business district, or Hong Kong’s International Finance Center (IFC), can potentially paralyze large parts of the economy. Against this backdrop, the emerging Asian megacity forces property insurers to constantly measure the exposure of clients, which potentially arises through manufacturing supply chains or administrative and management bottlenecks.

Last but not least, liability underwriters ought to carefully monitor the development of the megacity and its health-critical infrastructure. In particular, the quality standards of sanitation and sewage facilities can increase and decrease – or even cause – the spread of an infectious disease. The degradation of health-critical facilities and a subsequent pandemic outbreak, will potentially give rise to third party claims against semi-public or private infrastructure owners and operators, who are covered under annual liability policies. It would be negligent by underwriters to discount the risk arising from third party liability in a growing megacity. Globalization manifests itself in the megacity. Its authorities and citizens, especially the growing upper- and middle-class, will expect higher compensation and potentially fines to be paid for pandemic related damages, which will eventually affect liability insurers.

²⁴ Bell et al, 2009. P.1963. ²⁵ Kamps & Hoffmann C. (eds), 2003. P.15ff. ²⁶ The World Bank, 2015. ²⁷ Nield, 2016, and Stella, 2015.

Terrorism and Cyber-Threats

Conventional terrorist activity, such as shootings, bombings or attacks on planes, has constantly risen in recent years. The increase has been spurred by the prolonged existence of Al Qaeda and the emergence of the Islamic State in Iraq and Syria (ISIS). While recent ISIS attacks on western capitals like Paris and Brussels tend to dominate the media coverage, the threat of terrorism is equally distributed around the globe and does not differentiate between regions.²⁸

Before ISIS, multiple incidents, such as the Tokyo Sarin gas attack (1995), the New York September 11 tragedy (2001) and the Mumbai terrorist shootings (2008) had painfully illustrated the vulnerability of densely populated megacities to terrorist aggression. Subsequently, over the last decades a lot of thought has been given by researchers as well as metropolitan and federal governments about how to identify and minimize the impact on megacities from conventional terrorist attacks.²⁹

London and its response to the 1980s separatist-motivated terrorism of the Irish Republic Army (IRA) serve as forerunner and role model for many megacities in their effort to counter terrorist attacks. Although the solid web of closed-circuit TV (CCTV) cameras could not prevent the July 7 bombings of 2005, experts like Christof Bentele, Global Head of Crisis Management at AGCS, strongly believe that CCTV surveillance in combination with the “ring of steel”, i.e. barriers and check points, has been playing a crucial role in securing the British capital.³⁰

Insurers carefully monitor their exposure accumulation in megacities and subsequently adjust their pricing and deductible levels. To offer sustainable long-term solutions, this prudent approach is needed for two reasons: first, megacities regardless of their development stage or maturity level, offer attractive targets in form of landmark buildings, high-value assets, and central points of human

interaction. Second, the explosive population growth and ethnic-religious split, as can be often found in Asian megacities, serve as incubators for political unrest and terrorist activity.³¹

Working in a complementary manner with the authorities around the globe, the insurance industry has been providing a well-established terrorism insurance product with a clear definition for trigger and coverage. Prolonged disputes and claims settlement procedures – as they occurred after September 11³² – are unlikely to be repeated. Despite the current soft market, underwriters believe that the pricing is sound and supported by sufficient data. In many jurisdictions, governments provide pooling schemes which go hand in hand with the coverage provided by the insurance market.³³

The well-established market for terrorism insurance in combination with government backed pools gives peace to the minds of risk practitioners. Contrary the newly emerging cyber-threat, i.e. the potential of an attack via information technology (IT) systems executed by a disgruntled employee, hacker, hacktivist, cyber-terrorist or cyber-criminal and the subsequent damage, raises great concerns among insurance and business leaders.

This is underlined by two studies. In 2016, the WEF Global Risk Report states that “... cyber threats remain at the top of respondents’ minds, as in previous years...” and emphasizes that “... cyber dependency [...is being...] considered by survey respondents as the third most important global trend...” The Global Risk Report documents in detail that the cyber-threat has quickly climbed up the ranks to be perceived as one of the most likely and most impactful risk types.³⁴ The findings of the WEF are echoed by the Allianz Risk Barometer 2016, which compiles the views of more than 800 risk and insurance experts regarding the top-10 global risks. The

²⁸ From 2013 to 2014, for instance, a global increase of 35% in numbers of terrorism incidents and 81% of lives lost in terrorist attacks has been recorded. See: Marsh, 2015. P.2. See also: United States Department of State – Bureau of Counterterrorism, 2015. ²⁹ “Safety and Security in Megacities”, for instance, examines the efficiency and effectiveness of Tokyo’s centralized emergency operations center (EOC) versus Washington’s decentralized approach. Branscom, 2006.

³⁰ Bentele, 2016. ³¹ Felix & Wong, 2015. P.23. ³² Bagli, 2007. ³³ Marsh, 2015. P.14. ³⁴ World Economic Forum, 2016 (2). P.12 and P.18.

Risk Barometer lists political risks including terrorism ninth top risk. Despite continuous Jihadist aggression by ISIS and Al Qaeda, this ranking stays stable year on year. On the other side, cyber as a risk category has jumped in the Risk Barometer within three years from rank number 15 to number 3.³⁵

The sensitivity and concerns displayed in both studies is understandable given that in 2014 experts value the annual global economic loss created by cyber-crime to be close to \$450bn.³⁶ The list of reported cyber-attacks seems endless and reaches back to the late 1980s. Over the years, businesses from all segments – from finance to retail, from transport to manufacturing, from healthcare to entertainment – as well as public institutions including governments and presidential candidates have featured in the media after cyber-attacks.³⁷

For a city, the impact of a cyber-attack is correlated not only to its size but also to its degree of decentralization and “smartness”. Regarding decentralization, the governance structures of cities are – contrary to companies – often divided into public, semi-public and private organizations. The Jihadist bombings in April 2016 in Brussels have demonstrated that splitting authority and leadership between various – potentially even competing – stakeholders will create a surface wide open for attacks. Long before April 2016, experts had warned that the city’s governance with 19 mayors and six police departments represents a significant threat for itself and its neighboring cities.³⁸ Even though this example is taken from the area of conventional terrorism, it can analogously be transferred to the realm of cyber-threats.³⁹ Regarding smartness, literature generally holds that a smart city uses IT to improve the livelihood and security of its citizens. Megacities differ from smaller cities not only in their enormous size and high growth rates but also in both the depth and the range of their resources and the complexity – i.e. the smartness – of assuring the reliable functioning of all the services on which life depends. In short, for megacities, generally all three correlation parameters, i.e. size, decentralization and IT based smartness, are – with high likelihood – aggregated and can create an explosive mixture.

The smartness of a megacity shows in many ways. As one example, we described earlier how London has been using for decades an IT-based CCTV surveillance

mechanism to combat terrorism. Newer smart developments are, for example, waste management, which operates on as-needs-basis using containers equipped with volume signaling technology, or street lights, which are controlled by sensors to adjust to weather conditions, or the smart grid, which manages energy production real-time under the aspect of supply-demand and cost-efficiency.⁴⁰

The scenarios deriving from a potential attack on the IT-based communication system of a smart city are multifold and of differing impact. While dysfunctional waste management can create a difficult situation, a breakdown of London’s CCTV system due to a cyber-incident could severely cripple its strategy for counter-terrorism. Generally, a power-outage following an attack on the smart grid is described as the worst case. A recent simulation by Lloyd’s and the University of Cambridge offers a grim vision in terms of loss of lives and GDP.⁴¹ One can also travel back in time to August 2003 when a software bug resulted in a blackout including the NYC area. The bug was neither of criminal, hacktivist nor terrorist nature but affected more than 10 million people, caused 10 fatalities and cost several billion dollars.⁴²

Asia’s rich diversity and varying economic development stages are reflected in its megacities in terms of maturity and also IT-based smartness. Tokyo, for example, as Asia’s most mature and oldest megacity relies heavily on IT-based solutions for its inhabitants, for example, sensors, cameras and smart meters steer traffic, maintain security and manage electricity consumption. Low- or medium-mature megacities in Asia utilize IT to a lesser extent and are subsequently less exposed to cyber-threats. However, their vulnerability will increase starting with the area of public transport. As an example, newly commissioned Mass Rapid Transport (MRT) projects will make Asian capitals like Jakarta, Manila, and Bangkok increasingly smart. It is needless to say that, compared to rural areas and smaller cities, megacities notwithstanding their maturity level will always be the forerunner for applying IT with the goal to increase efficiency and improve the livelihood of their citizens.

The threat of cyber-attacks and the mission to protect IT-dependent megacities, their citizens and business against it, is one of the greatest conundrums to be faced by the insurance industry and authorities alike. Proportionally

³⁵ Allianz Risk Barometer 2016. ³⁶ McAfee, 2014. ³⁷ NATO Review Magazine, 2013. ³⁸ Becker & Diehl, 2015. ³⁹ Wong, 2015. ⁴⁰ Cerrudo, 2015. P.4ff. ⁴¹ Lloyd’s, 2015. P.7ff. ⁴² Barron, 2003.

with the spread of the “Internet of Things” and global interconnectivity, the frequency and severity of cyber-attacks have increased and will continue to do so.

Also, the nature, quality and complexity of potential cyber-claims have been evolving. While early on, cyber risk manifested itself in insurers’ books as claims for the loss or theft of personal data, nowadays cyber-attacks are executed with the goal to cause damage in the form of PD, BI and CBI. The US insurance industry was the early mover to develop wordings to cover cyber risks. However, the traditional US coverage mainly extends and limits itself to the loss of third party data. It therefore covers connected statutory liability, but has been neglecting the newly emerging, massively impactful exposure to PD, BI and CBI.⁴³ As a natural consequence, Peter Hacker, Partner at Distinction.Global, a specialized advisory unit of the Cyber Crime Institute, and Jens Krickhahn, Cyber Practice Leader for Central and Eastern Europe at AGCS, concordantly explain that there is no useful pool of first party claims data available – neither in the well-established US market nor in the newly developing cyber markets of Europe and Asia. This adds further to the dilemma of cyber underwriters.⁴⁴

How can the insurance industry cope with this situation and move forward in a meaningful way? Clearly, there are positive developments which need to be annotated.

Firstly, the industry is giving deep thought to the topic and employs experts for scenario planning and modeling. All major players, be it insurers, reinsurers or brokers, have invested in educational programs in order to help develop a deeper understanding of the subject matter. As a result, the broad impact of a potential cyber-attack has become more visible and to some extent quantifiable. For instance, the above mentioned blackout simulation meticulously documents the potential for first party claims (PD, BI and CBI), which could be lodged by utility companies, their corporate customers and their private clients, i.e. homeowners, as well as event organizers. Moreover, the study outlines how third party claims will affect the Liability, Error and Omission (E&O) and Directors and Officers (D&O) insurance programs of utility companies and their IT-suppliers.⁴⁵

Second, in addition to increased research and visibility, insurers are in the process of expanding coverage, reducing ambiguity and building up risk management

capabilities. For the latter, AGCS, as an example, has heavily invested in its in-house capabilities to offer cyber-related risk engineering services, which complement and support the technical underwriting of PD, BI and CBI exposures. Other insurers partner with third-party vendors from the IT consulting sector to support clients. Regarding coverage, leading insurers have gone beyond the traditional US-form, which had been geared towards third party exposure only, and have created a complete new section in the policy wording to deal with first party claims. Simultaneously, the industry has reduced ambiguity by recently dropping terrorism exclusions from cyber wordings, which has helped to overcome a problem that was grounded in semantics and ignored reality. While researchers, regulators and media are still engaged in a discourse to define the nature of cyber-attacks and discriminate between hacking, hacktivism, cyber terrorism and cyber-crime, the industry has moved beyond this. This has sent a positive signal and will increase confidence levels in the market.⁴⁶

Despite all this, the technical advancement of cyber-attackers, their capability to specifically target critical infrastructure and the relatively small available loss experience remain as major concerns for individual insurers. Considering the size of the cyber-threat in the light of rapidly growing megacities, the necessity becomes evident to create a new form of multilevel dialogue and cooperation which transcends the traditional circle of insurance practitioners. A formalized pattern of information sharing between insurers, reinsurers, brokers, as well as authorities and insureds is needed. Concretely speaking, it would be desirable to set up regular expert dialogue sessions, in which authorities exchange details about the latest cyber-trends on a confidential basis with the key staff, including Chief Security Officers⁴⁷, of insurers, brokers and other leading companies operating in the megacity’s territory. The insurance industry could lead the initiative together with the world’s megacities. Together, they could bring those companies, which are most knowledgeable about or susceptible to cyber-attacks, for example, telecommunication companies, utility companies, IT consultants etc., to the table in order to build up the necessary experience pool and start a “big-data-approach” to cyber-risk. In the long term, this knowledge exchange will be crucial to enable adequate pricing and establish best practices in cyber-underwriting and risk management.

⁴³ Smith, 2016, and Allianz Global Corporate & Specialty, 2015. P.5. ⁴⁴ Hacker, 2016, and Krickhahn, 2016. ⁴⁵ Lloyd’s, 2015. P.29ff. ⁴⁶ The confusion caused by semantics is best illustrated by the debate following the cyber-attack on Sony Pictures in 2014. See: Rothkopf, 2014. See also: Vitkowsy, 2014, and Yeo, 2015.

⁴⁷ On the role and growing importance of Chief Security Officers, see: Schlein, 2015.

Conclusion

Assessing the megacity's impact on the insurance industry is a fascinating challenge. Following or even better anticipating the trends, which can arise in the dynamic environment of the megacity, will occupy the mind of many future researchers. While this paper is focused on and dedicated to major life-threatening risks, there are plenty of other insurance relevant aspects in the context of the megacity. At this point, two aspects, household insurance and motor insurance, are worth a brief mention:

In the digital age, Google, Amazon and Uber have been noted as distribution channels or even providers for insurance, which could – because of their wide consumer appeal and databases – threaten and disrupt the traditional players and business models. In a megacity, however, where there are aggregations of business and personal consumers, many different forms of distribution or buying groups may emerge, whether deliberately formed by an insurer or intermediary, or self-formed because of proximity. For example, the residents of a sixty-story condominium could form a buying group solely

for the purpose of sourcing their domestic insurances and take their proposal to one or more insurance companies to negotiate the best deal. For insurers, the opportunity is to recognize the potential that exists within a megacity and to develop products and services that meet needs and lower costs because distribution is more efficient.

Motor insurance has been the backbone of large parts of the industry. The continuous emergence of the megacity will have a significant – potentially threatening – effect on motor insurers. First, as the degree of maturity develops in low- to medium-mature megacities, efficient public transport will become available to their citizens – especially in Asian capitals in the form of mass rapid transit (MRT) systems. Furthermore, the notion of car sharing may spill over from western societies. The combination of improved public transport and a rising share economy can severely reduce the amount of insurable cars and through this the available premium pool of motor insurers. Second, innovative megacities, which usually struggle with congested traffic, will – with high likelihood – be at the forefront to putting automated driving into practice. It can be assumed that human error, the major cause of vehicle accidents, will be reduced leading to fewer claims for damage and injury. But what if an accident does occur? The likely scenario is that the manufacturer of the vehicle – or possibly the vehicle's maintainer – will be looked to for compensation. Therefore, Public or Products Liability related claims may increase. Most likely, there will be a time lag before adequate modeling and pricing can be determined. What will happen in the meantime? Will insurers simply exclude cover for these vehicles, or will the price of insurance be prohibitive? The challenge needs careful consideration by the industry.

Returning to the risk categories, NatCat, pandemics, terrorism and cyber-threats, which were discussed in the main body of this paper, it needs to be annotated that the problems, which the world's megacities pose to insurers, concur with extremely competitive market conditions. These conditions have prevailed for quite a number of years. In the past, experts used to think of insurance markets in terms of hard and soft market



As the degree of maturity develops in low- to medium-mature megacities, efficient public transport will become available to citizens

cycles. At one point, the return between the hard and soft market was, on average, seven years. Now it seems as though the market is in a perpetually soft state. So much so that some in the industry do not see the current market conditions as a soft cycle but rather as the new norm. If this is correct, then addressing future risk exposures of the megacity – be it NatCat, pandemics, terrorism or cyber-threats or even a combination of those – may become too difficult for some insurers, leading them to exit the market entirely, or combine with another entity to create sustainable scale and financial robustness.

Viewing the risks, which are life-threatening for a megacity, through the four traditional lenses of Property, Revenue, People and Liabilities, a number of observations can be made as to the future risk landscape and some of the defining characteristics (*see table below*).

Insurance as a concept and as a product developed over many centuries. One key and lasting principle was that of risk sharing by many. This paper argues that in the context of today’s and tomorrow’s megacity, where the risk landscape is considerably different and constantly evolving in terms of quantity and quality, it is time to revisit the sharing concept.

For NatCat, this paper has demonstrated that a concentrated, PPP-like risk sharing between the insurance market and the government has been most efficient and effective to overcome the Thai flood disaster. The same is true for a pandemic-induced crisis as well as the threat of traditional terrorism, where government-backed terrorism pools and a dependable insurance product appropriately address the current critical situation.

Sharing on a different, advanced level, i.e. the level of data and analytics, is also helpful for dealing with NatCat, pandemics and terrorism. However, this new form of sharing is imperative in the area of cyber-threats to secure the livelihood of the megacity, its citizens and business. Over the past few years, a number of the world’s largest insurance, reinsurance and broking companies have established their own science, analytics and innovation departments or partnered with educational institutions to focus on emerging risks and the use of data to develop insurance solutions. Just as megacities will require their citizens to co-exist with greater reliance upon each other in a diverse, ever-changing environment, so must the insurance industry begin to pool its resources and share with other stakeholders, i.e. authorities and insureds, to develop solutions for the future.

Megacities: The future risk landscape

<p>PROPERTY</p> <ul style="list-style-type: none"> • Greater concentration of values in a more confined area • Potentially greater and faster spread of damage due to closer proximity between physical structures and operations • New technologies with potentially unforeseen prototype-related risks 	<p>REVENUE</p> <ul style="list-style-type: none"> • Greater interdependencies triggered by NatCat • Potentially longer periods for loss recovery and returning to revenue generation • Increase in pure financial loss or non-physical damage BI/CBI exposures
<p>PEOPLE</p> <ul style="list-style-type: none"> • Rising healthcare costs connected to a single infectious disease event • Densely populated areas as prime targets of conventional terrorists • Need for public transportation and susceptibility to cyber threats 	<p>LIABILITIES</p> <ul style="list-style-type: none"> • IT and cyber-driven risks emerging and leading to exposures in products liability and E&O insurance • Pandemic and terrorism risk related liability claims likely to increase

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