

Cambridge Judge Business School

Cambridge Centre for Risk Studies 2018 Risk Summit

CAMBRIDGE RISK FRAMEWORK: MANAGING ENTERPRISE RISK

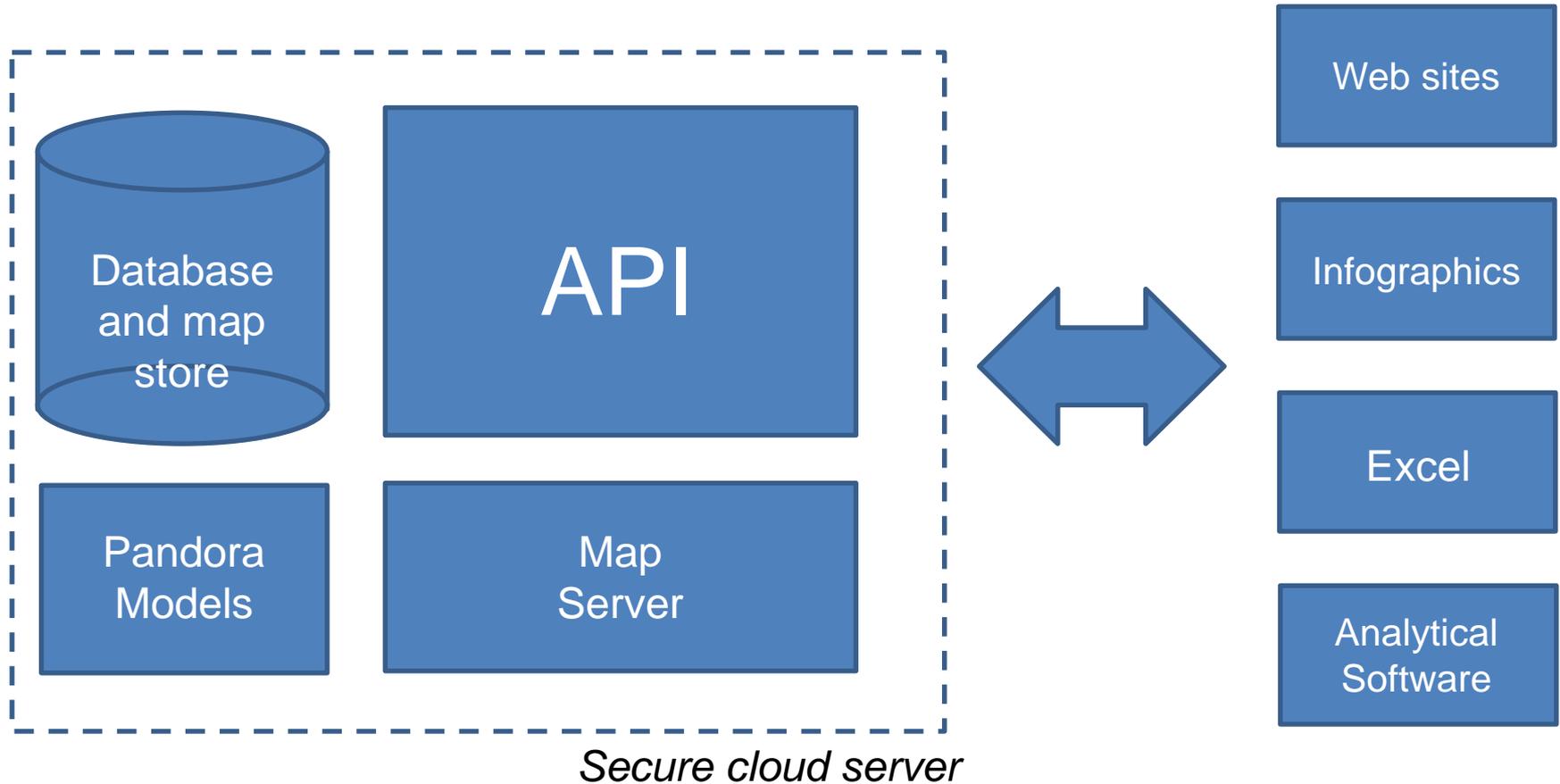
Simon Ruffle, Director of Research and Innovation
Centre for Risk Studies

Centre for
Risk Studies

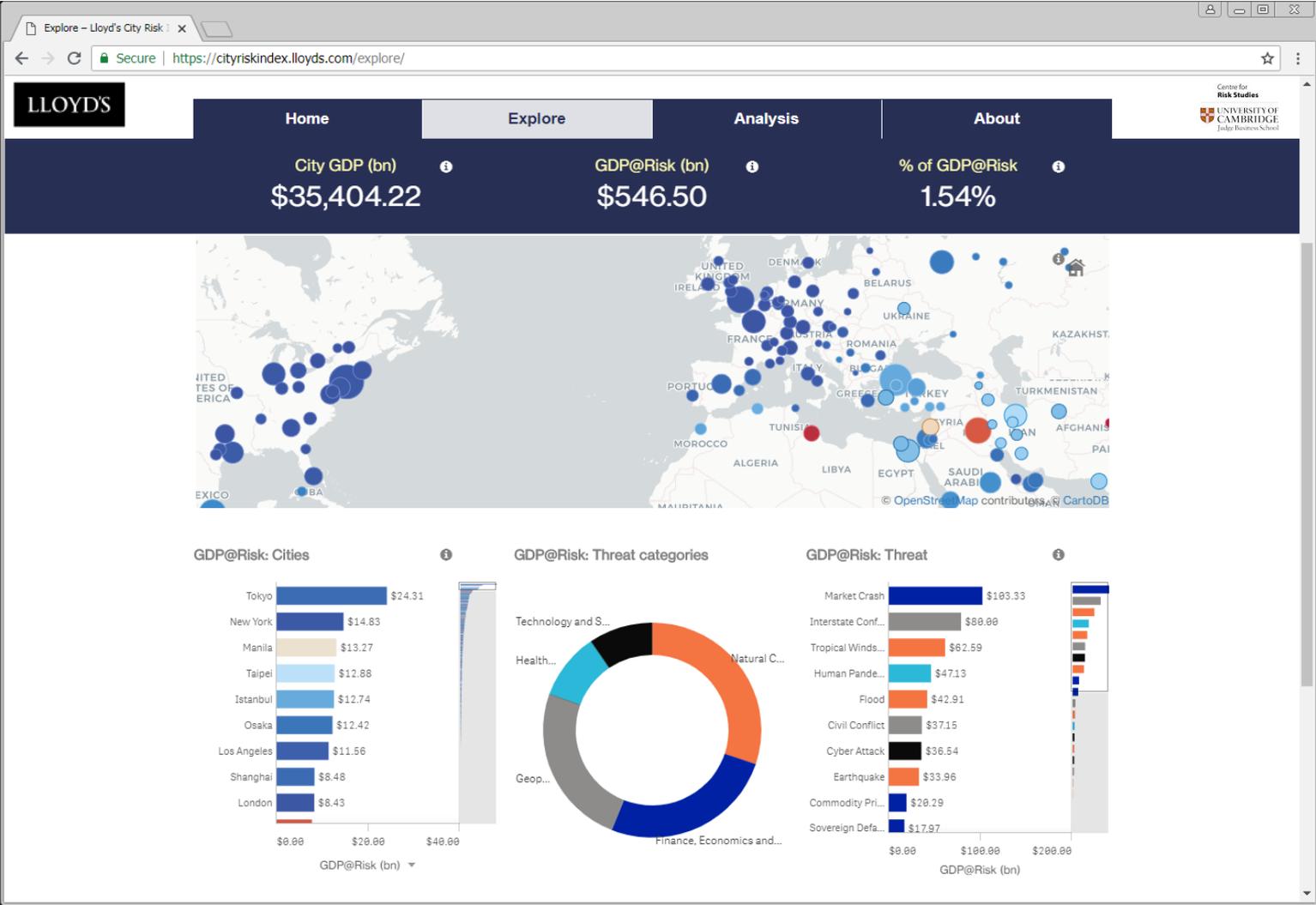


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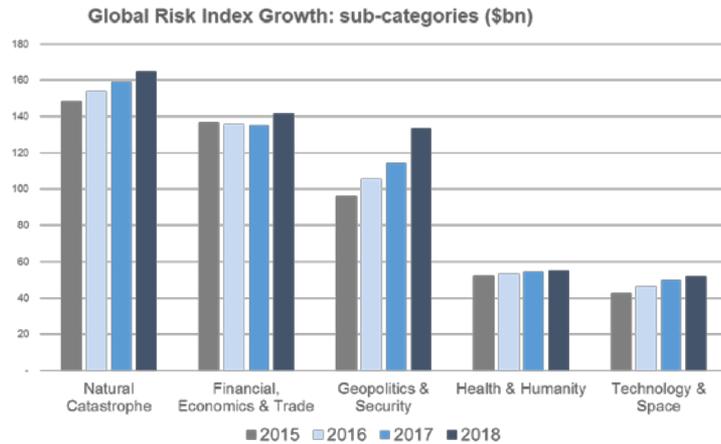
Cambridge Risk Framework



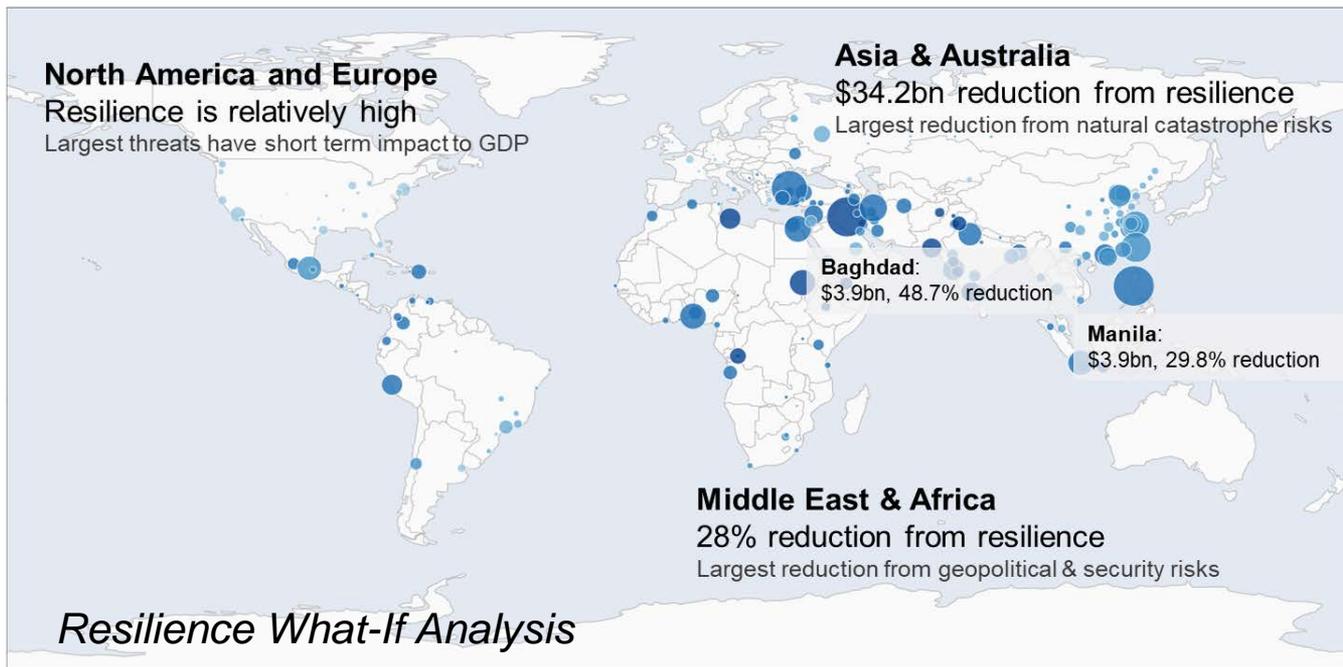
Websites



Infographics



City	Country	GDP@Risk (\$bn)	Top City Threat	GDP@Risk (\$bn)
Tokyo	Japan	24.31	Interstate Conflict	8.98
New York	United States	14.83	Market Crash	3.10
Manila	Philippines	13.27	Tropical Windstorm	7.39
Taipei	Taiwan	12.88	Tropical Windstorm	7.97
Istanbul	Turkey	12.74	Interstate Conflict	2.61
Osaka	Japan	12.42	Interstate Conflict	3.76
Los Angeles	United States	11.56	Earthquake	2.70
Shanghai	China	8.48	Tropical Windstorm	2.38
London	United Kingdom	8.43	Market Crash	1.83
Baghdad	Iraq	7.91	Interstate Conflict	4.37



Excel

city_result_nodes.xlsx - Excel Simon Ruffie

File Home Insert Page Layout Formulas Data Review View ACROBAT Tell me what you want to do

Clipboard Font Alignment Number Styles Cells Editing

Calibri 11 A A

Normal Bad Good Neutral Calculation Check Cell

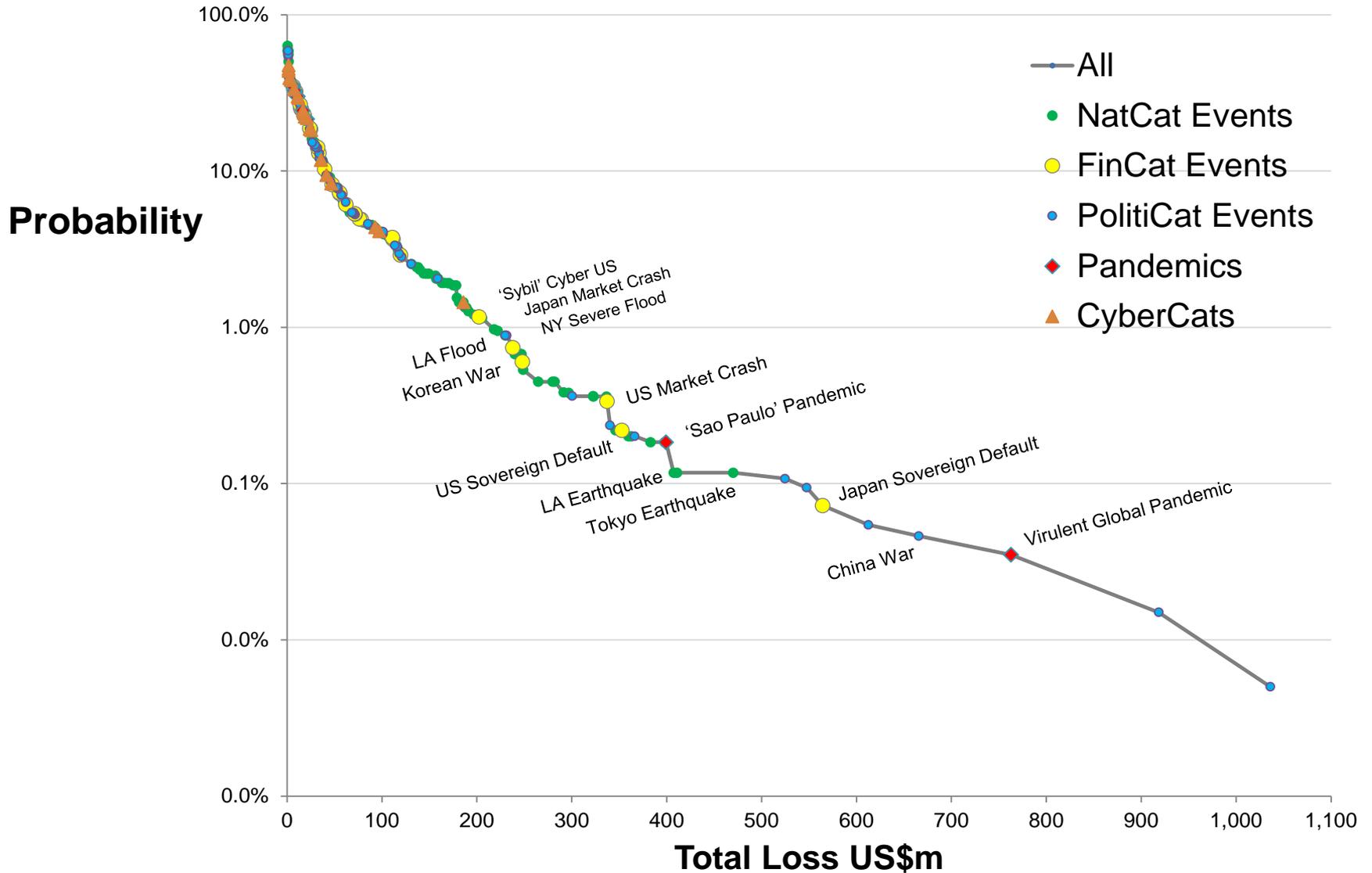
A1 =guid

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	guid	name	countrycode	country	regioncode	region	locationwkt	capitalcity	gdp_year_0	population_year	gdp_per_capita_y	expected_5yr_loss	expected_5yr_loss	expected_5yr_loss	expected_5yr_loss
2	civ_abd	Abidjan	CIV	Côte d'Ivoire	AF	Africa	POINT(-4.02189 5. n		14.18145	5009910	2830.679593	0	0	0	0
3	are_5274	Abu Dhabi	ARE	United Arab Emira	ME	Middle East	POINT(54.36667 24. y		141.1098	2173342	64927.56317	0.006862355	0	0	0
4	gha_gac	Accra	GHA	Ghana	AF	Africa	POINT(-0.20093 5. y		8.860014	2424756	3653.981679	0	0	0	0
5	tur_ada	Adana	TUR	Turkey	EE	Eastern Europe	POINT(35.32133 31. n		13.32683	1575903	8456.630897	0.000629846	0.000231895	0	0
6	eth_add	Addis Ababa	ETH	Ethiopia	AF	Africa	POINT(38.7468 9.0 y		9.412167	3507386	2683.527562	0	0	0	0
7	aus_sas	Adelaide	AUS	Australia	AU	Australasia	POINT(138.52083 -n		62.80133	1355546	46329.17658	0	0.023000732	0	0
8	ind_ahm	Ahmedabad	IND	India	CA	Central and South	POINT(72.58 23.03 n		27.70187245	7934976	3491.109797	0.001381453	0	0	0
9	irn_khz	Ahvaz	IRN	Iran, Islamic Repu	ME	Middle East	POINT(48.684 31.3 n		12.65691	1311268	9652.420405	0.000615008	0.000226432	0	0
10	egy_85969	Alexandria	EGY	Egypt	AF	Africa	POINT(29.91874 31. n		39.68878	5363762	7399.429729	0.001905877	0.0007017	0	0
11	dza_alg	Algiers	DZA	Algeria	AF	Africa	POINT(3.05 36.783 y		23.01117	3433210	6702.523295	0	0.000398725	0	0
12	kaz_alma	Almaty	KAZ	Kazakhstan	CA	Central and South	POINT(77.0405 43. n		43.69238	1729845	25257.97398	0	0.000772014	0.010134153	0
13	jor_amm	Amman	JOR	Jordan	ME	Middle East	POINT(35.93291 31. y		22.88142	4020146	5691.688809	0.00107812	0.000396939	0	0
14	nld_nhl	Amsterdam	NLD	Netherlands	WE	Western Europe	POINT(4.89484 52. y		124.1277	1526057	81338.83597	0.014240722	0.045186846	0.011435499	0
15	tur_ank	Ankara	TUR	Turkey	EE	Eastern Europe	POINT(32.853 39.9 y		87.92698	5522597	15921.31021	0	0.001536572	0	0
16	tur_ant	Antalya	TUR	Turkey	EE	Eastern Europe	POINT(30.709 36.8 n		12.38145	1045632	11841.11619	0.000586623	0.000215981	0	0
17	grc_cge	Athens	GRC	Greece	WE	Western Europe	POINT(23.653 37.9 y		96.98921	3757830	25809.89827	0.011199429	0.001680756	0	0
18	usa_geo	Atlanta	USA	United States of A NA	NA	North America	POINT(-84.349 33. n		378.0204	5975549	63261.19993	0.043476679	0.019607325	0.034912382	0
19	nzl_ack	Auckland	NZL	New Zealand	AU	Australasia	POINT(174.761 -36 n		70.0308	1614884	43365.83928	0	0.003651027	0.006500941	0
20	usa_aus	Austin	USA	United States of A NA	NA	North America	POINT(-97.74306 31 n		142.704	2155095	66217.03452	0.006729602	0.007445596	0	0
21	irq_bgh	Baghdad	IRQ	Iraq	ME	Middle East	POINT(44.398 33.3 y		53.76173	7306987	7357.578438	0.002564249	0.000944098	0	0
22	usa_balt	Baltimore	USA	United States of A NA	NA	North America	POINT(-76.6683 35 n		190.2969	2831629	67204.03697	0.021842331	0.069307304	0.043029886	0
23	idn_jba	Bandung	IDN	Indonesia	SE	Southeast Asia	POINT(107.607 -6. n		30.49274	9159761	3328.988606	0	0	0	0
24	ind_krn	Bangalore	IND	India	CA	Central and South	POINT(77.58773 11. n		74.05408039	11049200	6702.21196	0.00377625	0	0	0
25	tha_kth	Bangkok	THA	Thailand	SE	Southeast Asia	POINT(100.51667 y		207.7965	16525970	12573.93666	0	0	0	0
26	esp_9870	Barcelona	ESP	Spain	WE	Western Europe	POINT(2.17340349 n		158.2832	4728161	33476.69422	0.007437199	0.002738207	0	0
27	chn_bjn	Beijing	CHN	China	EA	East Asia	POINT(116.38804 y		448.1959	22272210	20123.54858	0	0.008084238	0.106121042	0
28	lbn_byr	Beirut	LBN	Lebanon	ME	Middle East	POINT(35.5 33.883 y		26.68354	2255433	11830.78371	0	0.000468278	0	0
29	srb_bel	Belgrade	SRB	Serbia	EE	Eastern Europe	POINT(20.41256 44 y		16.2048	1690402	9586.358748	0.001892931	0.000284082	0.003729117	0
30	bra_mge	Belo Horizonte	BRA	Brazil	LA	Latin America	POINT(-43.909 -19 n		57.11437	5787675	9868.275257	0	0	0	0
31	deu_ber	Berlin	DEU	Germany	WE	Western Europe	POINT(13.32757 51. y		176.2988	4465448	39480.65233	0.008257964	0.064283736	0.039910972	0
32	gbr_bir	Birmingham	GBR	United Kingdom	WE	Western Europe	POINT(-1.86334 52 n		155.9569	3971925	39264.81492	0.007294728	0.056785474	0.01437078	0
33	col_bog	Bogotá	COL	Colombia	LA	Latin America	POINT(-74.07583 4 y		80.56105	8121059	9920.01782	0	0	0	0
34	usa_mss	Boston	USA	United States of A NA	NA	North America	POINT(-71.103 42. n		436.7862	4862605	89825.55647	0.0204817	0.285863337	0.098988632	0
35	bra_bras	Brasília	BRA	Brazil	LA	Latin America	POINT(-47.92083 -y		66.59277	3085393	21583.23753	0	0	0	0
36	svk_brat	Bratislava	SVK	Slovakia	EE	Eastern Europe	POINT(17.2127 48. y		29.17987	748004.7	39010.27627	0.003391008	0.001529293	0.006680362	0
37	cog_poo	Brazzaville	COG	Congo, Republic o	AF	Africa	POINT(15.28514 -4 y		4.647868	1960157	2371.171289	0	0	0	0
38	aus_ons	Brisbane	AUS	Australia	AU	Australasia	POINT(153.026 -27 n		124.0377	2465958	50300.00511	0.005890967	0.00216892	0	0

city_result_nodes

Ready

Analytical Software



Risk Quantification for Corporates

- Need to communicate Probability, Return Period and Exceedance Probability Curves
- Companies are organised in different ways
 - By markets, brands, regions, products, functions
- What outputs and reports are needed by risk managers and the Board?
 - To Support Business Decisions
 - We want consistency of infographics across threats, geographies, organisational units

Risk Overview

● Overall index

○ Your index

Finance, Economics and Trade



Market Crash
Sovereign Crisis
Commodity Prices



...Global recession 'unlikely' Carney...

Geopolitics and Security



Interstate Conflict
Terrorism
Separatism Conflict
Social Unrest



...US launches Syrian attack...

Natural Catastrophe and Climate



Earthquake
Tropical Windstorm
Temperate Windstorm
Tsunami
Flood
Volcanic Eruption
Drought
Freeze
Heatwave



...Earthquake in the Philippines...

Technology and Space



Nuclear Accident
Power Outage
Cyber Attack
Solar Storm

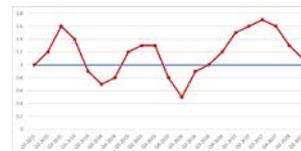


...Cyber Attacks on White House...

Health and Humanity

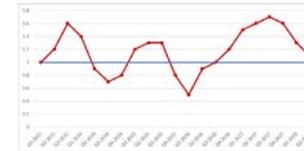


Human Pandemic
Plant Epidemic



...Epidemics in Thailand...

Regulation and Liabilities



...Increase in D&O class actions...

Processing real-time cyber terrorism developments

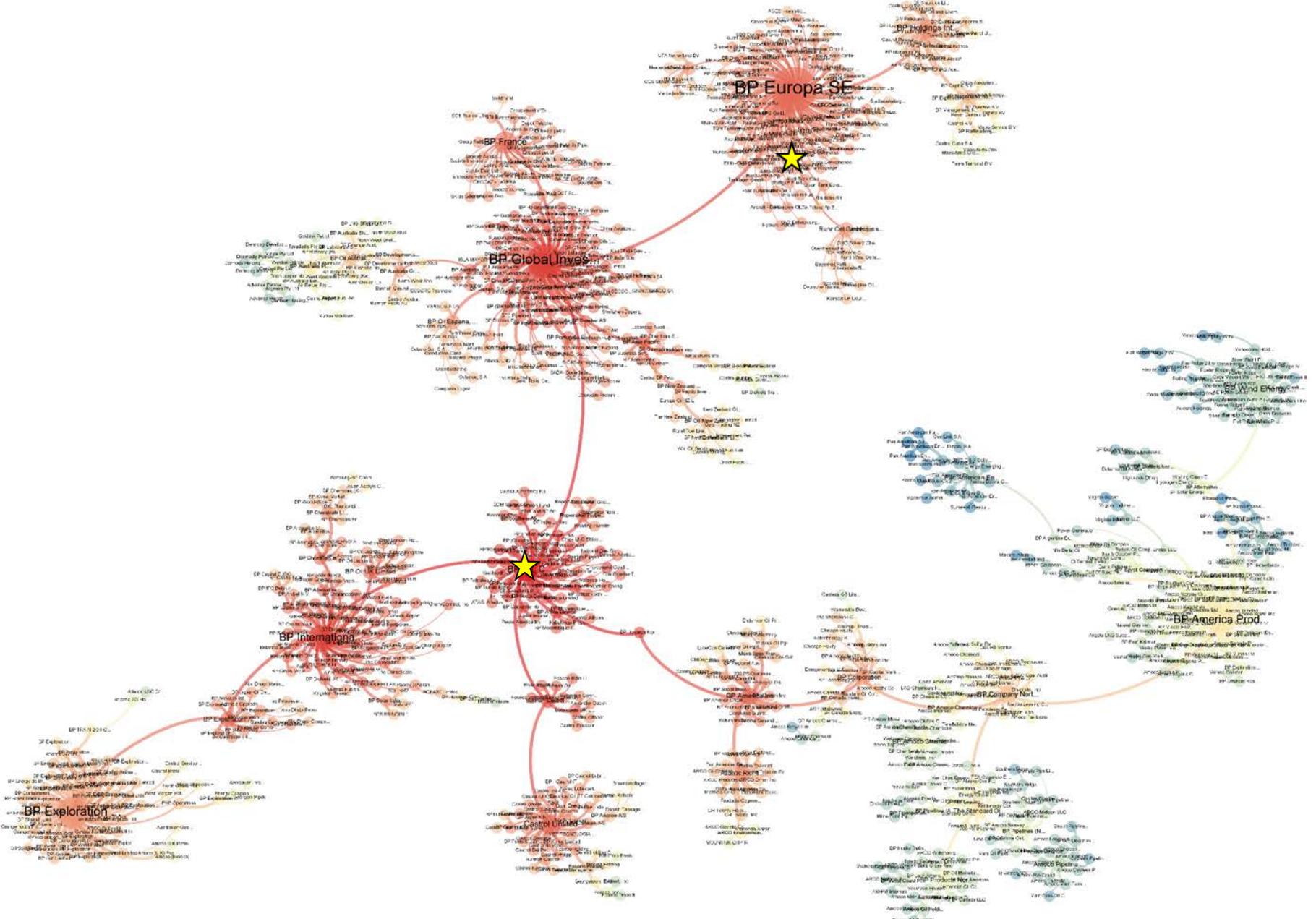
The screenshot shows the Mendeley Desktop interface. On the left is a list of documents with columns for Authors and Title. On the right is a detailed view of a document titled "Worldwide Threat Assessment of the US Intelligence Community" by ODNI, published in 2018. The details include an abstract, tags, author keywords, city, institution (ODNI), and a URL.

Is	Attribution	Actor	Class		
Multiple Western ICS Breaches	Dragonfly 2.0	Nation State APT	Destructive		
ern ICS in Energy Sector	Most Likely Russian APT	Nation State APT	Destructive		
h ICS in Energy Sector	Most Likely Russian APT	Nation State APT	Destructive		
Carolina Election Breaches	Most Likely Russian APT	Nation State APT	Disruptive		
ergy Sector GCHQ-ICS	Most Likely Russian APT	Nation State APT	Destructive		
Web Marketplace Claiming T	Cyber Criminal	Cyber Criminals	Destructive		
on Campaign Breach	Most Likely Russian APT	Nation State APT	Disruptive		
leaks Vault 7 Dump	Hacktivists or APT	Hacktivists	Disruptive		
ive Diskwiper That Functions	Cyber Terrorists/Hacktivists	Cyber Terrorists	Destructive		
ements Advocating The Ove	The Binary Guards	Cyber Terrorists	Disruptive		
inated Attack on City of Cha	Anon	Hacktivists	Disruptive		
Force Attack on Scottish Par	Likely Nation State APT	Nation State APT	Disruptive		
ivists Release Info on GOP S	Anon	Hacktivists	Disruptive		
illion NHS Records Stolen (D	Anon	Hacktivists	Disruptive		
alian 1st Responder Comms	Pirate Broadcaster ?	Hacktivists	Disruptive		
ntec Finds APTS in Western	Most Likely Russian APT	Nation State APT	Destructive		
ax 143 Million Details Exfil	Cyber Criminal Organisation	Cyber Criminals	Disruptive		
h Ministries Dealing With Ir	Cyber Terrorists/ Hacktivists	Cyber Terrorists	Disruptive		
Contractor Has NSA Exploits	Most Likely Russian APT	Nation State APT	Destructive		
10/10/2017	Malware	North Korea Penetrates US ICS/Pe	North Korean APT	Nation State APT	Destructive
10/10/2017	Data Exfil	North Korean APT Steals OP Plan	North Korean APT	Nation State APT	Disruptive
11/10/2017	DDoS	Targeted DDoS Attack Against Sw	Most Likely Russian APT	Nation State APT	Destructive
12/10/2017	DDoS	Targeted DDoS Attack Against 3rd	Most Likely Russian APT	Nation State APT	Destructive
20/10/2017	Malware	APT Conducting R&D In Energy An	Likely Nation State APT	Nation State APT	Destructive
24/10/2017	Malware	Bad Rabbit Ransomware, Based O	Most Likely Russian APT	Nation State APT	Destructive
30/10/2017	Malware	Cybercriminal Group Targeting Int	Cyber Criminals	Cyber Criminals	Disruptive
31/10/2017	Ddos? Def	Hacktivists Bring Down Several Sp	Anonymous	Hacktivists	Disruptive
06/11/2017	Defaceme	Team System Dz Multiple Defacer	Team System Dz	Cyber Terrorists	Disruptive
14/12/2017	Malware	TRITON Malware Attacks ICS and	Likely Nation State APT	Nation State APT	Destructive
	Hacktivists	Destructive	Cyber Criminals		
	Nation State APT	Disruptive	Cyber Terrorists		

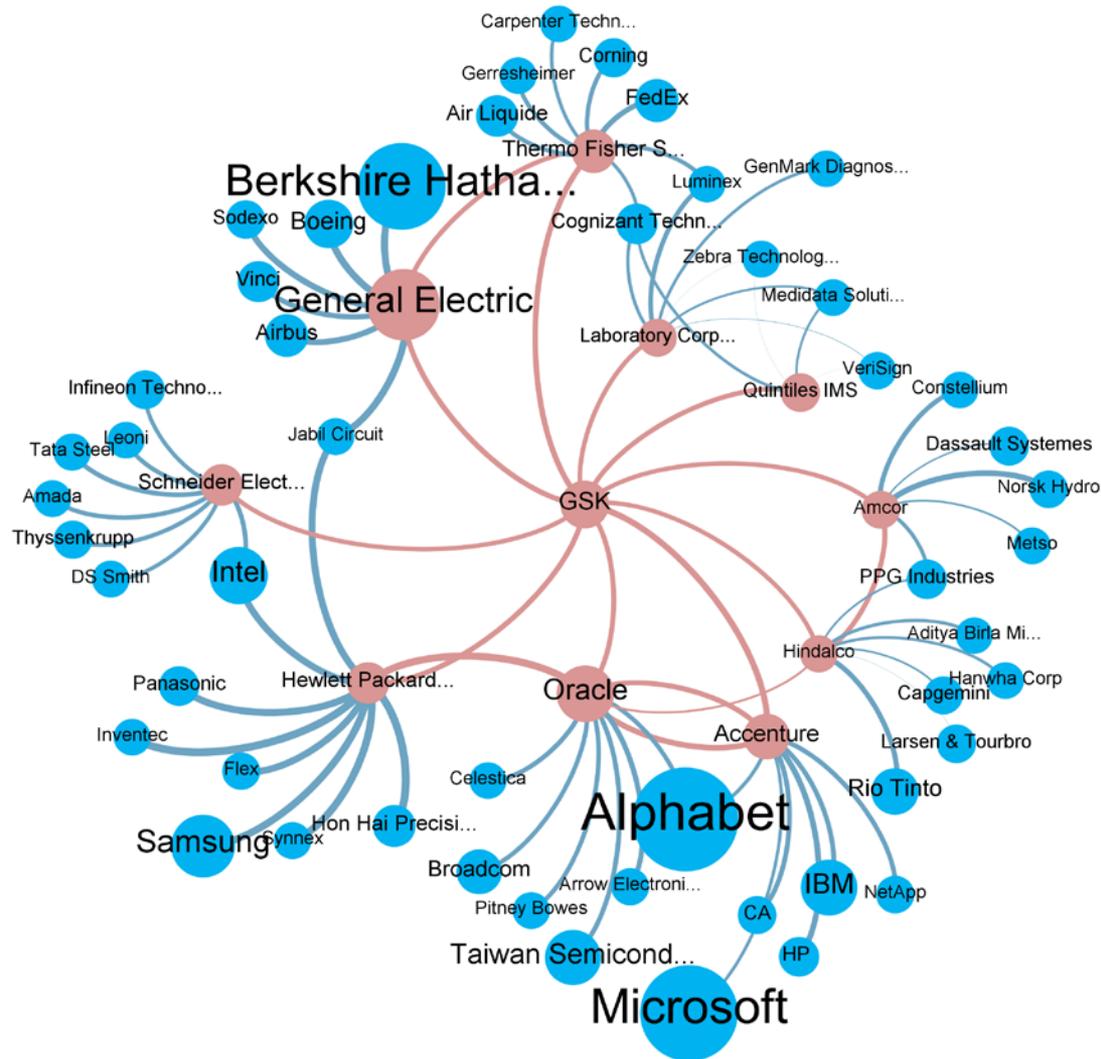
Corporate Threat Overview as Map



Corporate Threat Overview as Organograph



Corporate Threat: Counterparties



Node Size by
Market Capitalization
of Company

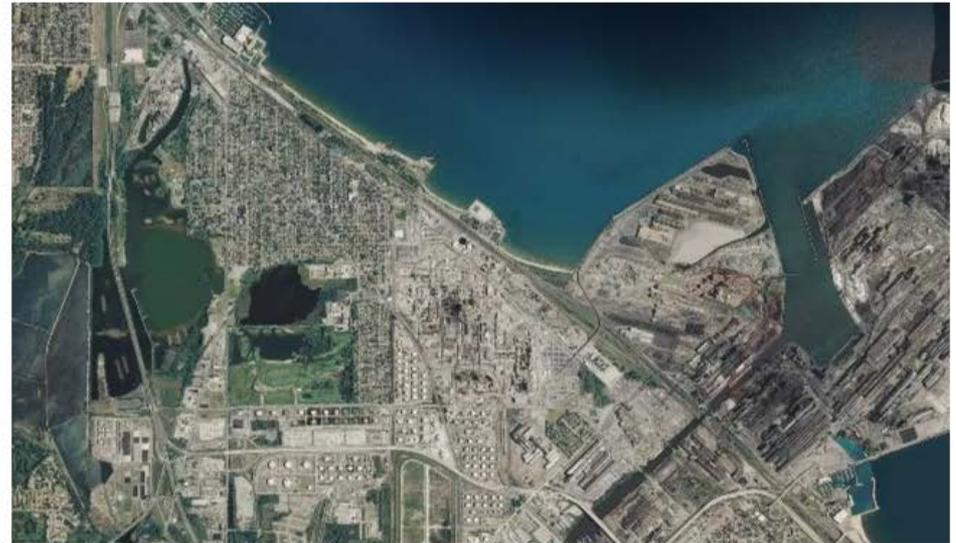
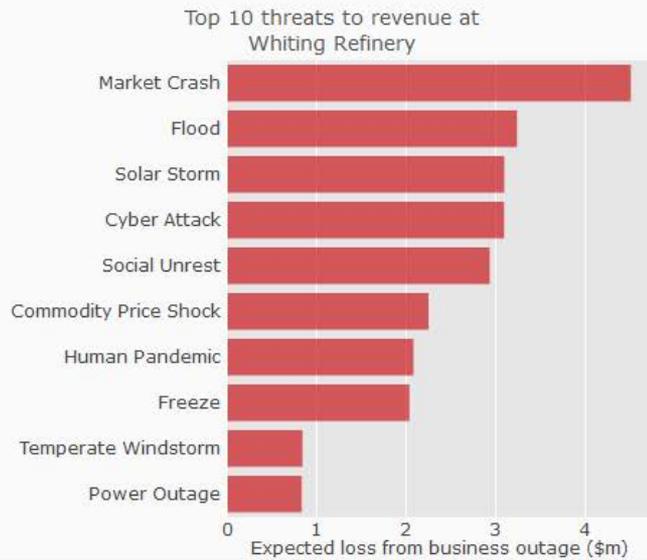
Site Specific Risk Assessment

Business Outage Repair Cost People Risk

Top threats by productivity unit

Select productivity unit:

Whiting Refinery



Total expected loss from business outage: \$27.01m

Risk Mitigation (Resilience Manager)

Odds of Occurring Next 12 Months	Scenarios
1 in 50	Terrorist Attack
1 in 100	600 lb car bomb 100 m away
1 in 200	1 ton truck bomb
1 in 250	2 ton
1 in 500	5 ton
1 in 1,000	10 ton tractor-trailer
1 in 10,000	Attack with sarin gas

Physical Measures
Install Vehicle Perimeter Exclusions
Highly Visible Security Guards
Employee Awareness Program
Blast/Shatter Proof Glass
Anti-combustible HVAC
Higher grade Structural Engineering
Other

Site Insurance Purchasing (Risk Transfer Manager)

Insurance Profile RUN INSURANCE ANALYSIS

Active?:

Product name:

Type of Cover:

Limit (\$m):

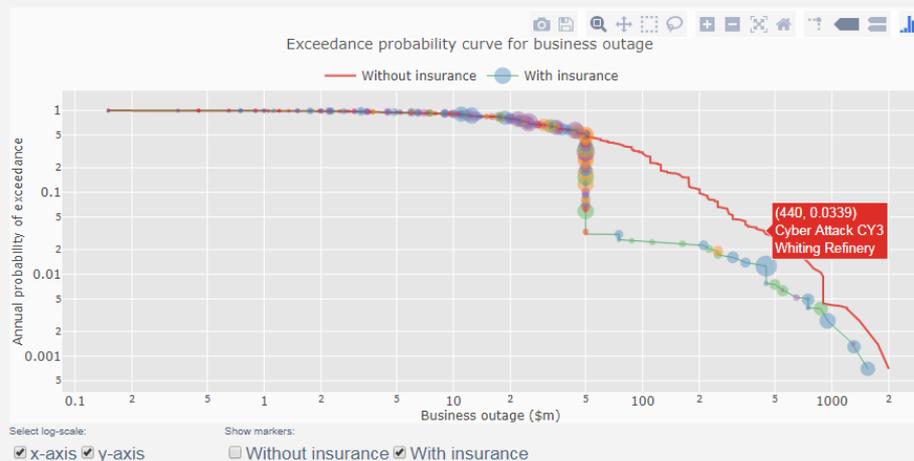
Deductible (\$m):

Exclusions:

Units applied:

Whiting Refinery	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cherry Point Refinery	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
BP-Husky Toledo Refinery	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Texas City Chemicals	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cooper River Chemicals	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mad Dog Installation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Atlantis Installation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Thunder Horse Installation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Na Kika Host Facility	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Prudhoe Bay Oil Field	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
NM San Juan Basin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
CO San Juan Basin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Insurance exceedance probability curve



Loss process:

Business Outage Repair cost

Indicate a loss level (in \$m) of concern:

A business outage loss level of \$100m has a 29.5% chance of being exceeded without insurance and a 2.6% chance of being exceeded with insurance

Indicate an exceedance probability (%) of concern:

There is a 5% chance of exceeding a business outage loss level of \$300.0m without insurance and \$50.0m with insurance

Risk Transfer by Insurance

Select company:

Loss process:

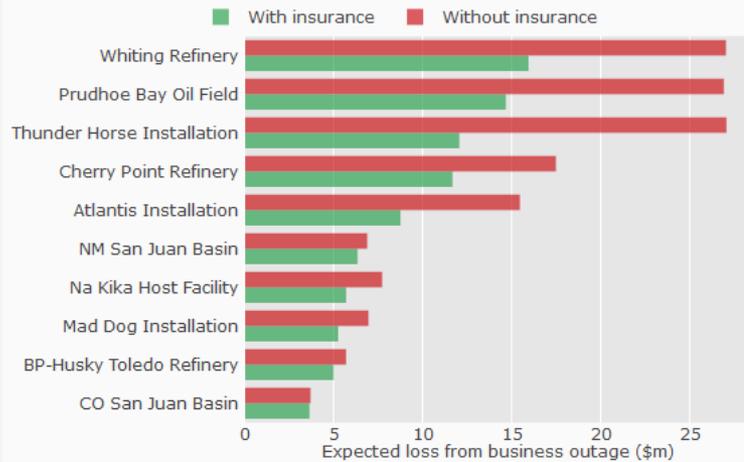
Business Outage Repair cost

Top productivity units by threat

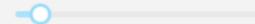
Select threat:

Select threat:

Top 10 productivity units with revenue at risk from All Threats



Threat layer opacity:

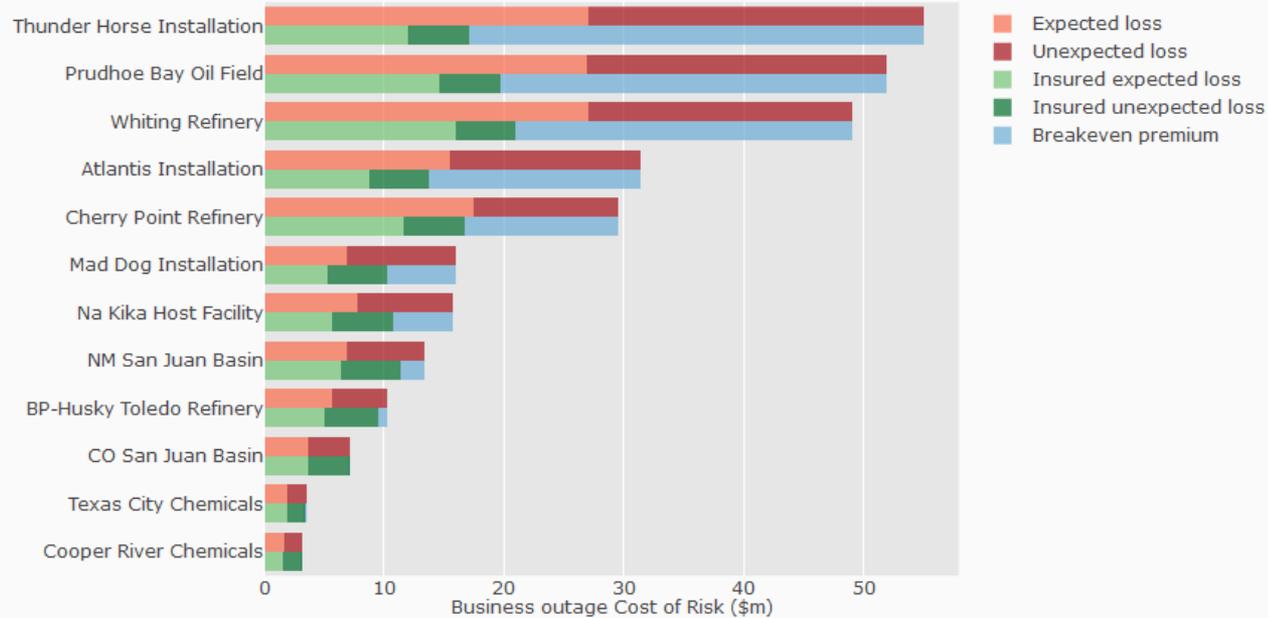


Insurance could reduce the total expected loss from All Threats business outage from \$148.46m to \$92.54m

Cost of Risk

Cost of Risk Analysis

Locations ranked by business outage Cost of Risk



Cost of capital (%):

10

Risk appetite return period:

100

Corporate Level Scenarios

Loss Process	Magnitude	Vulnerability	Potential Cause	Odds per yr
Contagious Malware	Over 1% infection of key servers	Network traffic scanning	Ransomware	1-in-200
Data Exfiltration	Over 10M PII records	Network intrusion	Malicious External	1-in-250
Data Exfiltration	Over 1M PCI records	Payment process malware	Malicious External	1-in-500
Contagious Malware	Over 10% infection of general devices	Firewall and AV failure	Diskwiper	1-in-600
Counterparty Failure	Serious Bug in MM Platform software	Third party plug-ins	QA in supplier	1-in-750
Financial Theft	Multiple multi-million bank transfers	Bank transfer authentication	Insider or External	1-in-800
Data Exfiltration	Over 100K PHI records	Access control failure	Insider	1-in-900
Contagious Malware	Infection of Media Management Platform	Network traffic scanning	Targeted payload	1-in-1,000
Denial of Service	Ultra high intensity DDoS on Server, 7 days continuous	Web Application Firewall	Hacktivist external	1-in-4,000
Denial of Service	Very high intensity DDoS on Server, 20 days intermittent	Web Application Firewall	Hacktivist external	1-in-4,800
Counterparty Failure	4+ day cloud outage: Object storage; US	Cloud platform continuity	Human error	1-in-5,000

Selected cyber threat scenarios giving a company a \$50 million loss from one cyber cause or another with cumulative likelihood of around 1 in 50

Risk Metrics for Balance Sheet Impact

- Key Drivers of Risk
- Key Scenarios
- Metrics
 - Debt/Equity Ratio
 - Probability of Downgrade
 - 1 in 100 year loss
 - Probability of Profit Warning
 - Probability of Ruin
 - Valuation Risk Premium
 - Risk Contribution by Business Unit

Centre for
Risk Studies



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