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Delivering Successful Futures

Assessing the Wider Resilience of the Defence Industrial Supply Chain

Jay Edwards – July 2015

International Symposium on Military Operational Research (ISMOR)

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- **Research Aim**
- Historical Supply Chain Problems
- Literature Review
- Vulnerability Assessment Framework
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Research Aim

Recent catastrophic weather events such as Hurricane Katrina in 2005 and the 2011 Tohoku earthquake & tsunami resulted in severe disruption to global supply chains. This study has been conducted to assess the wider resilience of the UK Ministry of Defence (MOD) industrial supply chain.

This study was carried out by CORDA for the Dstl Resilience Programme (Defence Science and Technology Laboratory) under the 'Operational Analysis Capabilities Collaborative Analysis' framework and was sponsored by ACDS Log Ops (Assistant Chief of Defence Staff, Logistical Operations) and DE&S QSEP (Defence Equipment & Support, Quality Safety and Environmental Protection).

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Historical Supply Chain Problems

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- Natural hazards which have impacted a government defence agency financially or operationally:
  1. BAE Systems – Johnson City (Flood)
  2. AWE – Burghfield (Flood)
  3. USAF – Homestead Air Force Base (Hurricane)

- Wider supply chain problems which have impacted a government defence agency financially or operationally:
  4. Chinese Counterfeit Goods
  5. Lockheed Martin – Fort Worth (Strike)
  6. BAE Systems – Samlesbury (Cyber Espionage)

1. BAE Systems - Johnson City

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Source:
WBNG, BAE Intends to Stay, September 2011, http://www.wbng.com/news/local/BAE-Assessing-Damages-No-Guarantees-129688708.html

1. BAE Systems - Johnson City

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Facility

- Located in New York State
- Head Office for Legacy Platform Solutions Sector
- Diverse facility containing production, design, test, repair, admin

Event

- Flooded 8th September 2011
- Over 16 Million gallons of flood water
- Critical equipment recovered, cleaned and installed in a nearby facility within two weeks
- New facility opened a year later

Impact

- BAE Systems
  - Financial Loss

- DOD
  - Financial Loss
  - No operational impact due to BAE Systems rapid recovery and supply chain redundancy

2. AWE - Burghfield

Source:
Nuclear Information Service, Public pay £5m for flood damage, July 2010, http://www.nuclearinfo.org/article/awe-burghfield/public-pay-five-million-pound-bill-flood-damage-uks-nuclear-weapons-factory

2. AWE - Burghfield

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Facility

- Atomic Weapons Establishment (AWE) at Burghfield, near Reading, Berkshire
- Site responsible for the final assembly of Trident mounted nuclear warheads, their in-service maintenance and their eventual decommissioning.
- AWE plc is owned by a consortium of Jacobs Engineering Group, Lockheed Martin UK, and Serco
- All AWE sites remain owned by the UK government who also holds a golden share in AWE plc

Event

- Flooded 20th July 2007
- All the buildings in the key nuclear assembly area were inundated by floodwater
- Could have been a critical accident however due to the timing of the flood (Friday afternoon) the majority of radioactive material had been removed from processing facilities and returned to storage

Impact

- MOD
  - Approximately £6m flood related costs
  - Disruption to nuclear weapons manufacture for 9 months (no live nuclear work in this period)

Source:
The Telegraph, Britain's Nuclear Weapons factory nearly overwhelmed, October 2008, http://www.telegraph.co.uk/news/uknews/defence/3178392/Britains-nuclear-weapons-factory-nearly-overwhelmed-by-flood.html
GetReading, Taxpayers £5m bill for AWE Flooding, July 2014, http://www.getreading.co.uk/news/local-news/taxpayers-5m-bill-awe-flooding-4224736
Nuclear Information Service, Public pay £5m for flood damage, July 2010, http://www.nuclearinfo.org/article/awe-burghfield/public-pay-five-million-pound-bill-flood-damage-uks-nuclear-weapons-factory

3. USAF - Homestead Air Force Base

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Source:
F-16.net, Hurricane Andrew F-16's destroyed, http://www.f-16.net/forum/viewtopic.php?t=5458

3. USAF - Homestead Air Force Base

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Facility

- Located in Southern Florida
- Approximately 75 F-16's in the 31st Tactical Fighter Wing

Event

- Hurricane Andrew 27th August 1992 – 2nd most destructive hurricane in US history
- Most of the F16's evacuated before hurricane hit
- Majority of the 2000 buildings on the base became severely damaged or unusable
- 2 years later 1/3 site redeveloped as an Air Reserve Base and the rest sold to developers

Impact

- DOD
  - 3 F-16's that were not airworthy at the time were heavily damaged by the hurricane
  - Approximately $100m in repair and rebuild costs
  - No significant operational impact due to the number of other USAF bases that could be used

Source:
Air Special Report, Ten Year After Andrew, August 2002, http://www.air-worldwide.com/_public/NewsData/000258/Andrew_Plus_10.pdf
Los Angeles Times, A ghost town air base, March 1993, http://articles.latimes.com/1993-03-15/news/mn-433_1_air-force
F-16.net, Hurricane Andrew F-16's destroyed, http://www.f-16.net/forum/viewtopic.php?t=5458

4. Chinese Counterfeit Goods

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Problem

- Investigation by US government reported 1,800 Chinese counterfeit cases covering a total of 1 million individual parts
- Investigators traced 70 percent of the cases back to China and nearly 20 percent of the remainder were traced to Britain and Canada - resale points for counterfeit Chinese parts
- Majority of counterfeit components are disposed components which are then cleaned, sanded down and reprinted with fake product markings

Examples

- SH–60B Navy helicopter – counterfeit electronic parts found in forward-looking infrared (FLIR) system (night vision capability) – one of the FLIRs was sent to the USS *Gridley* in the Pacific fleet
- C–27J Transport aircraft – counterfeit parts found in display unit which failed during routine testing
- P–8A Poseidon surveillance aircraft – counterfeit parts found in ice detection module which failed during a test flight
- Terminal High Altitude Area Defence (THAAD) missiles - counterfeit parts found in mission computers

Impact

- DOD
  - Financial – To replace parts in THAAD missiles it cost the DOD approximately $2.7m
  - Operational impact due to delays due to investigations and replacing parts – no catastrophic failures although this is obviously a risk

Source: US Government Printing Office, Investigation into Counterfeit parts in DOD supply chain, http://www.fdsys.gov/

5. Lockheed Martin – Fort Worth

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Facility

- Lockheed Martin, Fort Worth, Texas
- Aircraft assembly and manufacturing work on the F-35, F-16 and F-2 fighter jets

Event

- 2-week strike by 4000 unionised staff in April 2003
- Workers had foregone raises due to the global economic crisis however demanded compensation in 2003 due to Lockheed Martin's improved profits
- Lockheed Martin brought in non unionised labour but they lacked the technical skills required

Impact

- Israeli Air Force
  - 3 month delay in delivery of the first of 100 F-16's
- Hellenic and Egyptian Air Force
  - Unknown delay in delivery of F-16's

Source:
F-16.net, F-16 deliveries to mid east allies will be delayed, http://www.f-16.net/f-16-news-article837.html
Globes, Delay in supply of F-16 to Israel due to Lockheed Martin Strike, http://www.globes.co.il/en/article-701330

6. BAE Systems – Samlesbury

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Facility

- BAE Systems MA&I in Samlesbury, Lancashire is the major manufacturing hub for its part of the F-35 manufacturing, building the aft fuselage, vertical and horizontal tails for the jet

Event

- Cyber espionage reported in 2009 and again in 2012 against BAE Systems (Lockheed Martin was also targeted)
- It is likely that certain details about the design and performance of some systems for the F-35 Joint Strike Fighter were stolen

Impact

- DOD and F-35 Partner Nations
  - Financial – There are reports that the cyber attacks resulted in programme delays and increased costs due to investigations and redesign of critical equipment
  - Operational – Adversaries are able to reduce technological advantage, the Chinese J-31 stealth fighter is reportedly modelled on the F-35

Source:
DefenseTech, Did Chinese Espionage Lead to F-35 Delays?, February 2012, http://defensetech.org/2012/02/06/did-chinese-espionage-lead-to-f-35-delays/
DEF, Top official admits F35 Fighter Secrets Stolen, June 2013, http://breakingdefense.com/2013/06/top-official-admits-f-35-stealth-fighter-secrets-stolen/

Supply Chain Problems Conclusions

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- Government defence agencies are vulnerable to supply chain risks that can cause a financial and operational impact.
- Important to take into account the full spectrum of risks - natural hazards, political unrest, pandemics, counterfeit goods, IT security etc.
- The approach taken in this study can be used to identify and monitor the full spectrum of risks

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Literature Review

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- **Supply Chain Risk Management (SCRM)** – A review of academic and publically available supply chain risk management literature carried out by Cranfield University.

- **Natural hazard risk** – A review of natural hazard risk literature and a review of publically and commercially available databases carried out by CORDA.

- **Supply chain management software** – A review of publically and commercially available software which can be used to map supply chains and manage risk carried out by CORDA.

Standard SCRM methodology

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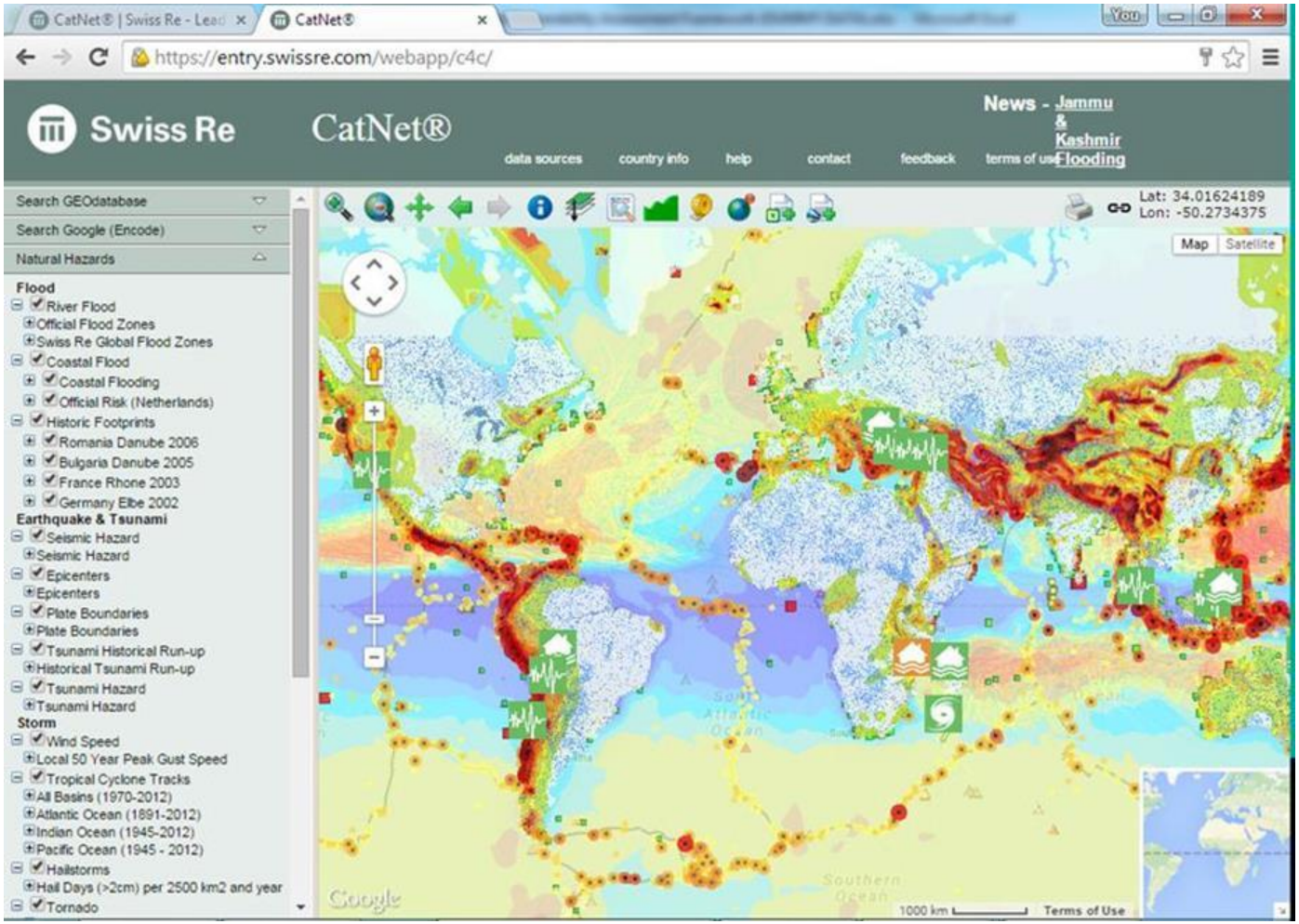
Natural Hazard Risk



Source
'CatNet', *Swiss RE*, http://www.swissre.com/clients/client_tools/about_catnet.html

Supply Chain Management Software

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Vulnerability Assessment Framework

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1. Identify the Node -
The location and organisation name

2. Calculate the Node Risk Rating (NRR) -
The natural hazard risk at the node

3. Calculate the Node Impact Rating (NIR) -
The risk the natural hazard will adversely impact the node

4. Calculate the Supply Chain Impact Rating (SCIR) -
The impact on the supply chain if the node became non operational

5. Calculate the Aggregated Risk and Impact Rating (ARIR) -
A summary rating of the risk at the node so that the nodes in a supply chain can be sorted from highest to lowest risk

Vulnerability Assessment Framework

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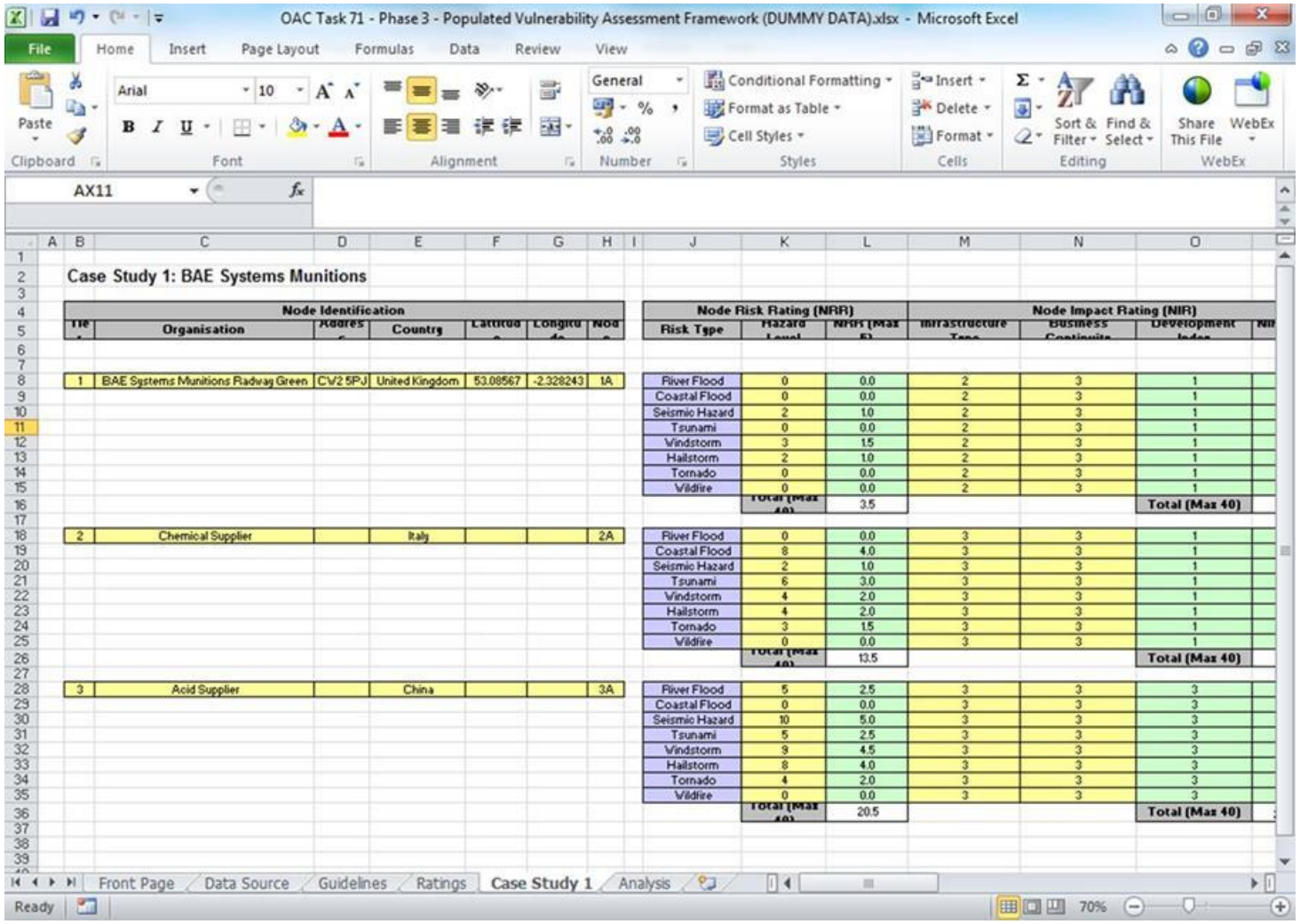

Vulnerability Assessment Framework Conclusions

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1. The Vulnerability Assessment Framework offers a standard format for collecting and storing supply chain data.

2. The Vulnerability Assessment Framework offers a standard format for the creation of questionnaires.

3. The data in the Vulnerability Assessment Framework can be used to create a list of nodes in a supply chain from most risky to least risky.

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Three Case Studies

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1. BAE Systems Munitions
2. BAE Systems Maritime Services
3. Morgan Composites & Defence Systems

We can identify the highest risk nodes in a large supply chain

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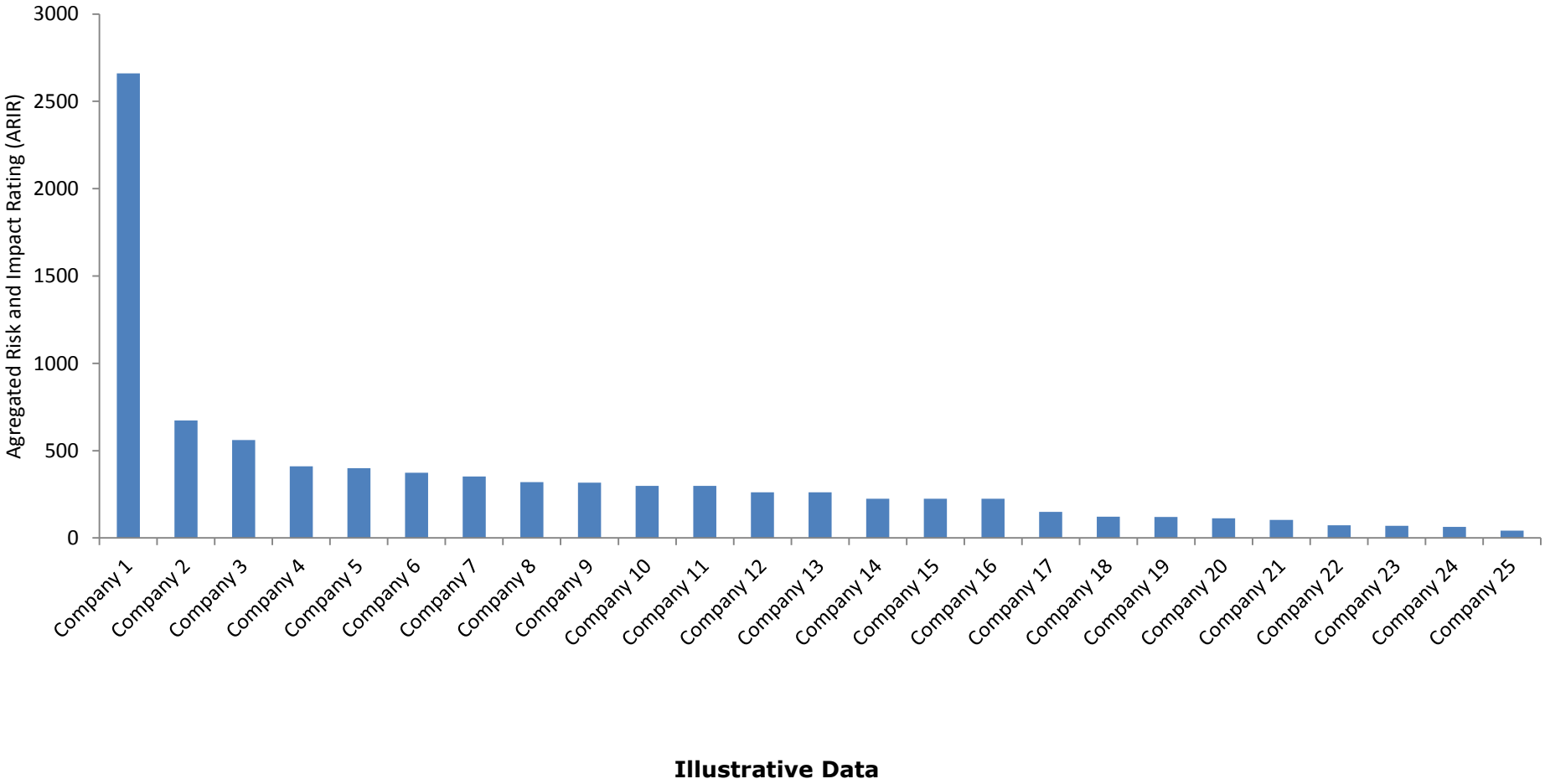
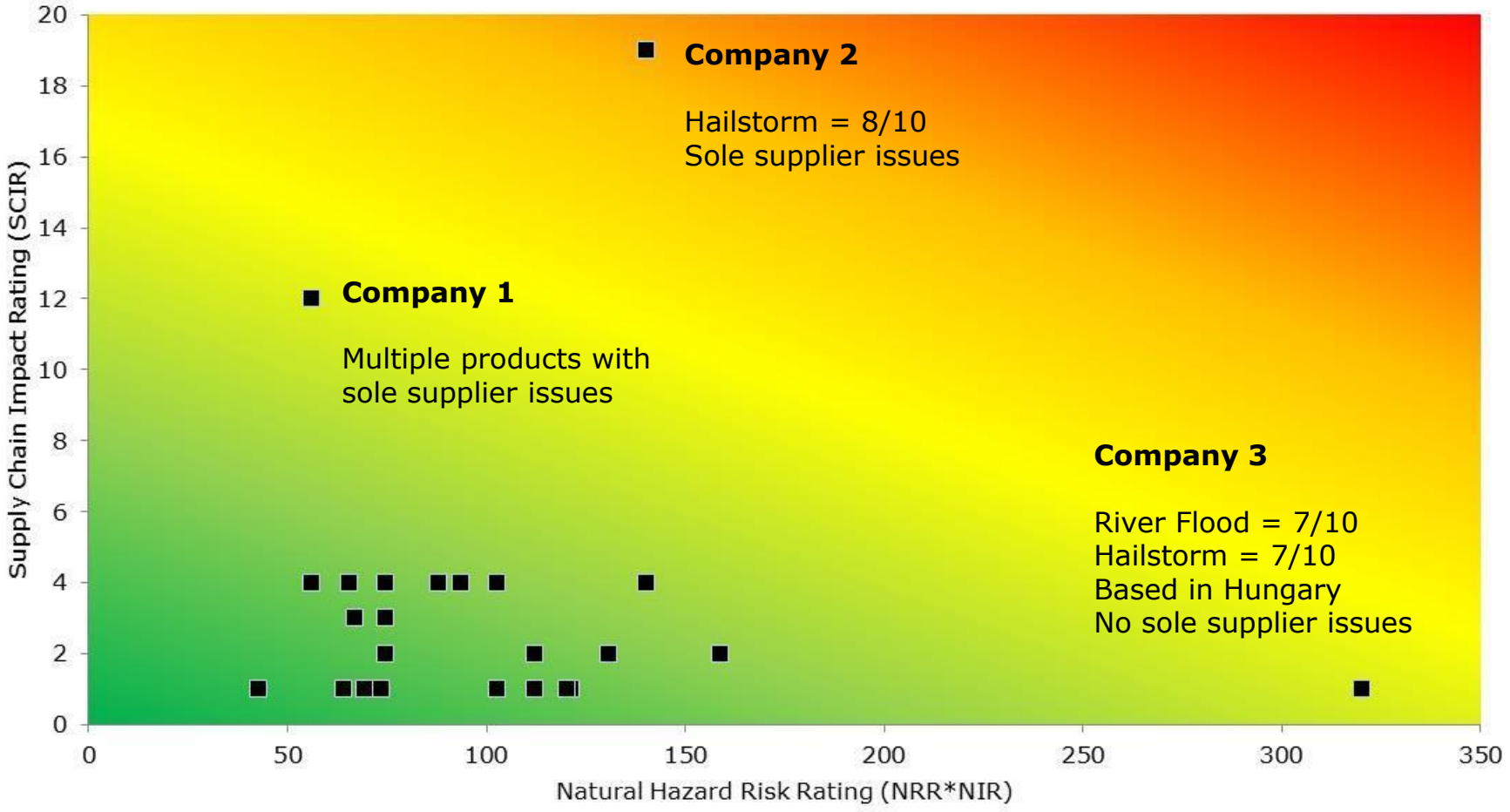


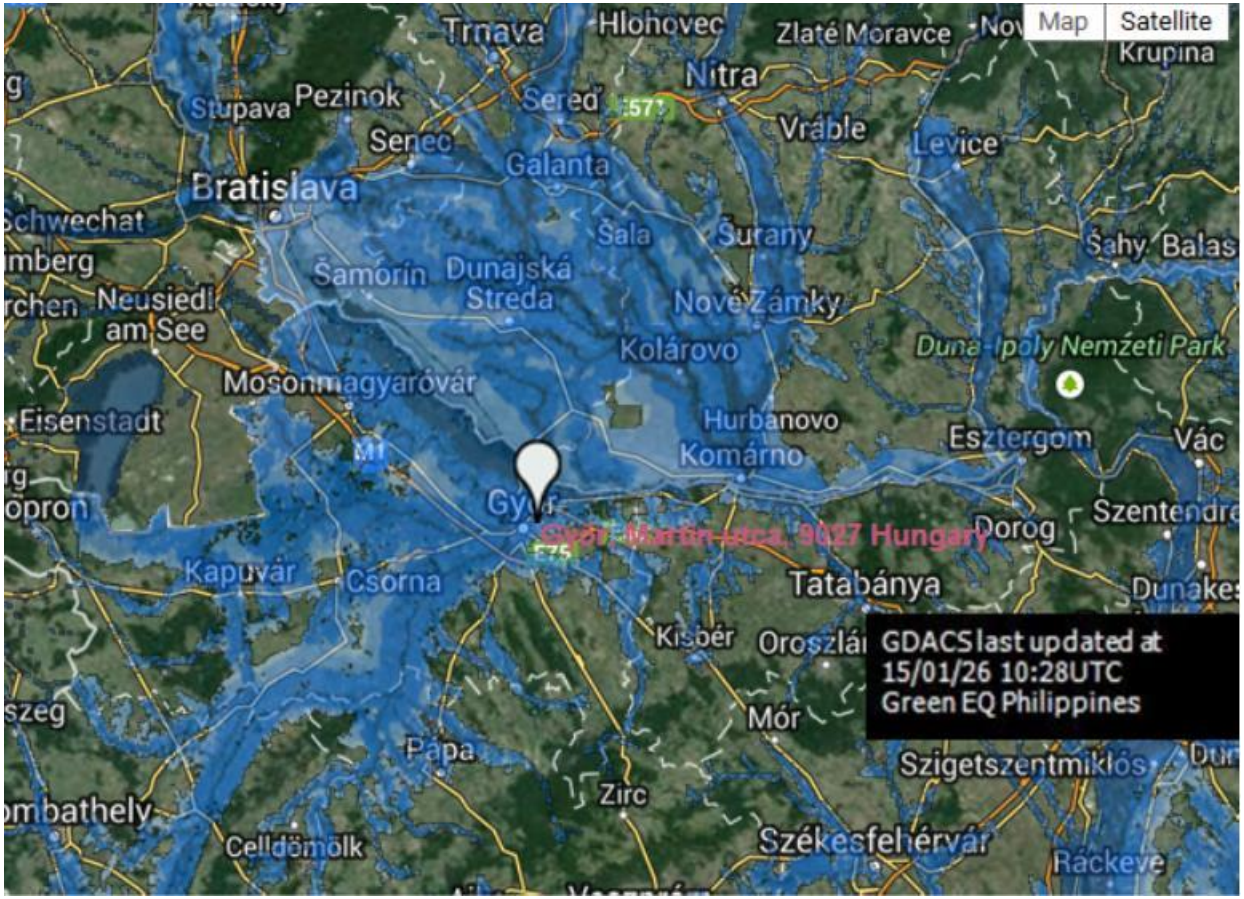
Illustrative Data

We can identify the highest risk nodes in a large supply chain



Illustrative Data

Company 3
River Flood Hazard Level 7/10 (50 year return period)



River Flood

- 10 years
- 20 years
- 30 years
- 50 years
- 100 years
- 200 years
- 250 years
- 500 years
- >200 years
- >500 years

Source
'CatNet', *Swiss RE*, http://www.swissre.com/clients/client_tools/about_catnet.html

Case Study Conclusions

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1. The populated Vulnerability Assessment is a powerful tool allowing the highest risk nodes to be quickly identified.

2. It has been difficult to collect data in an ad hoc manner, line of communication is lost as the number of supply chain tiers increases.

3. The case studies show that the MOD's supply chains become increasingly global as the supply chain tier increases and there are nodes that are subject to significant natural hazard risk.

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Two pilot approaches

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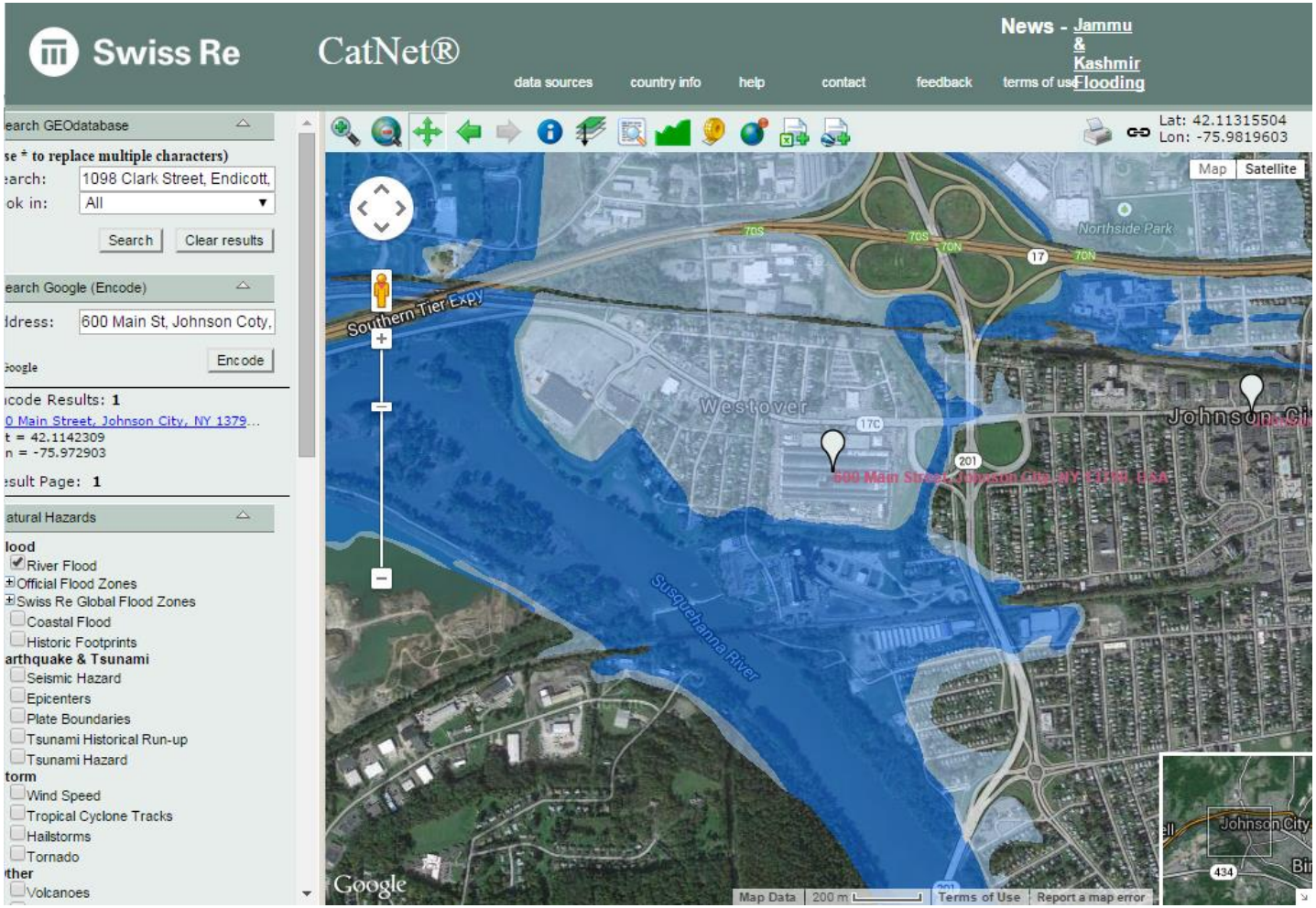
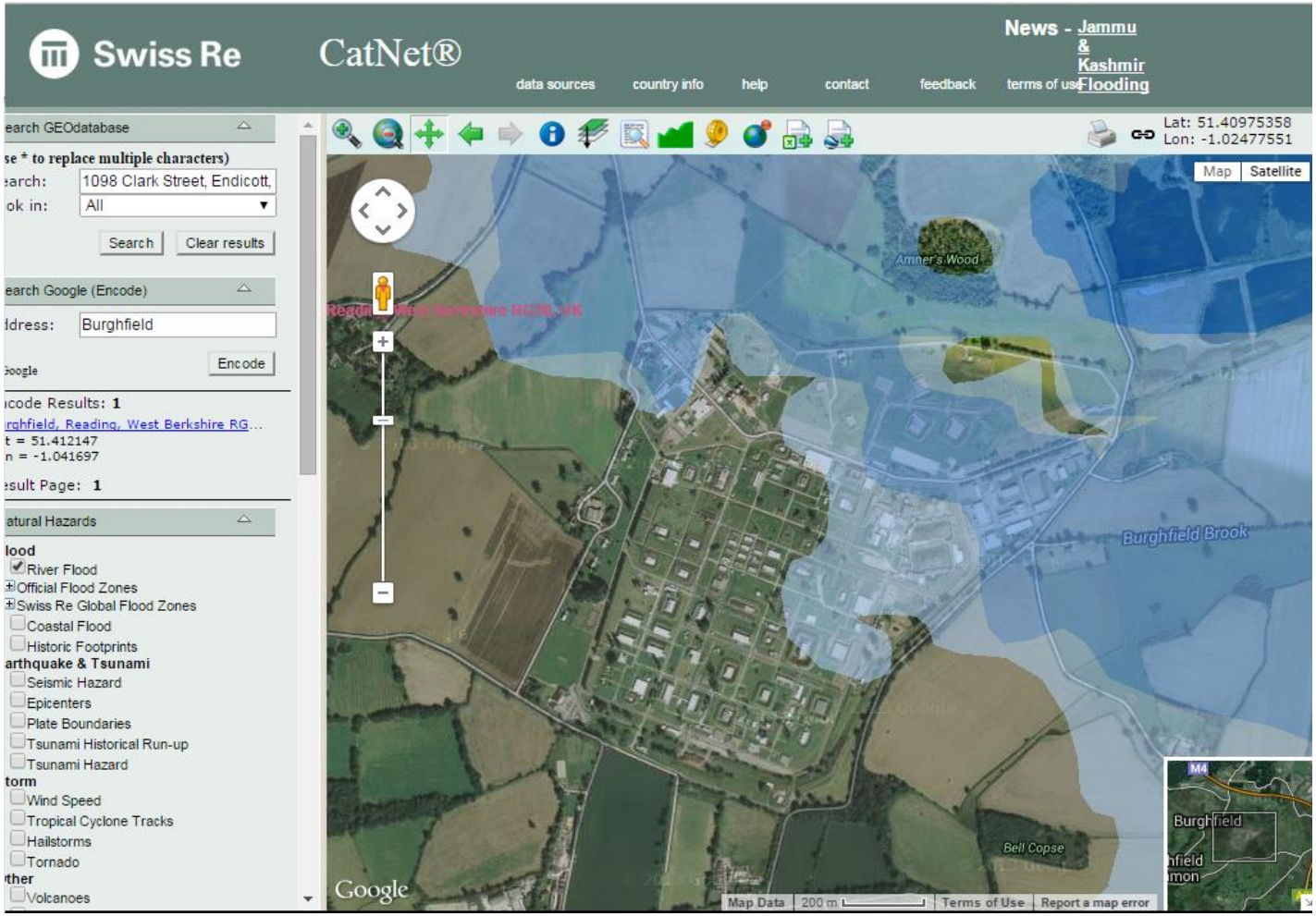
CatNet®

Swiss RE CatNet



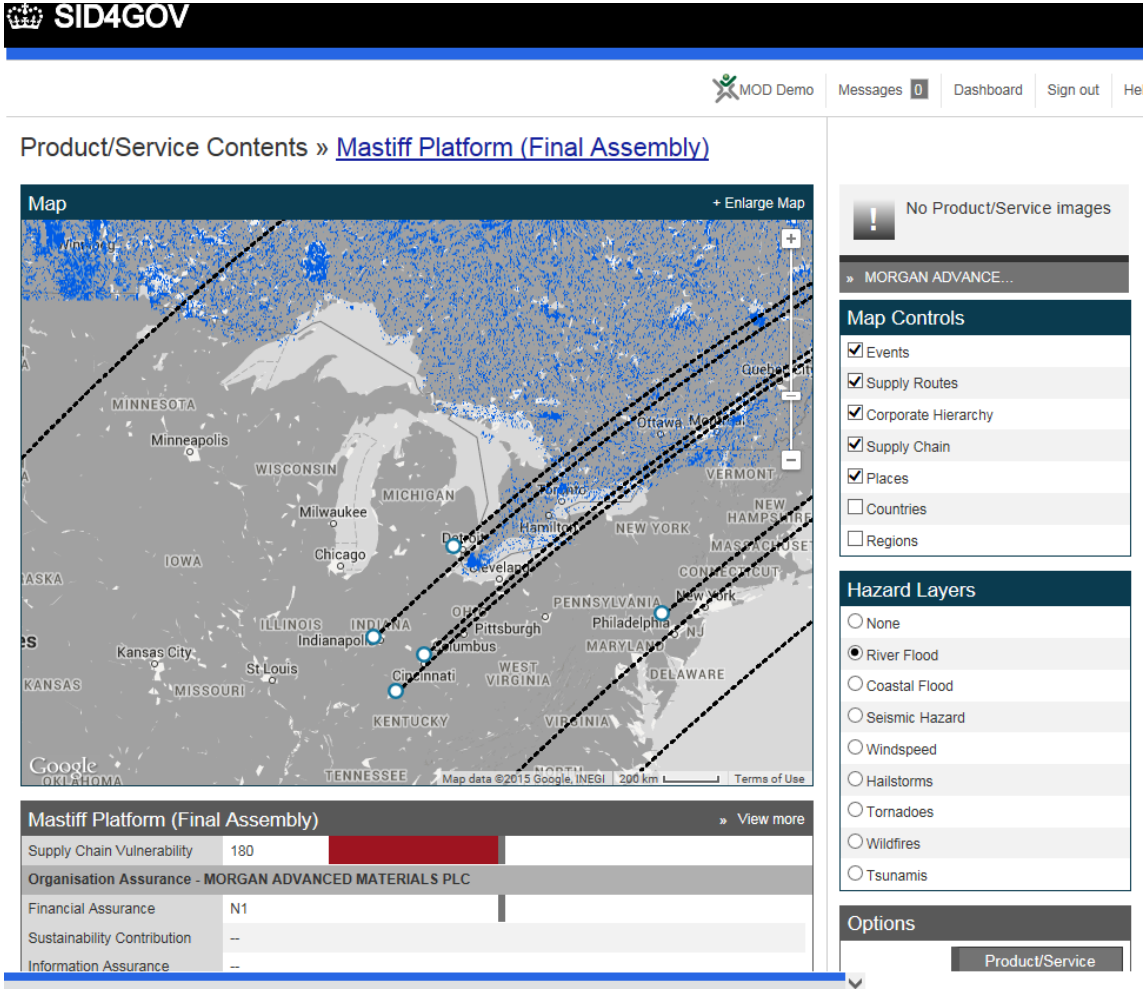
Source
'CatNet', *Swiss RE*, http://www.swissre.com/clients/client_tools/about_catnet.html

Swiss RE CatNet



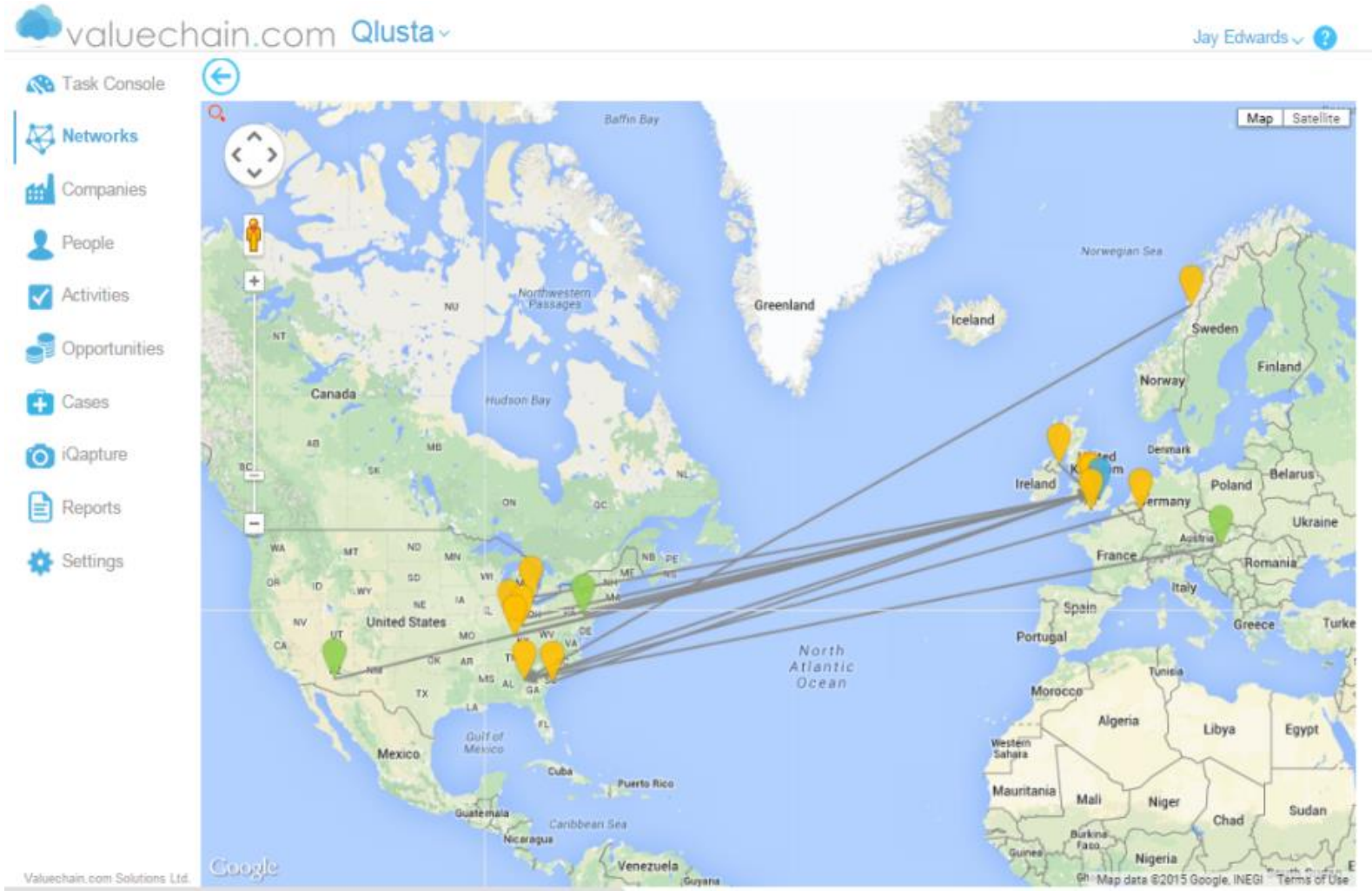
Source
'CatNet', *Swiss RE*, http://www.swissre.com/clients/client_tools/about_catnet.html

NQC



Source
NQC, http://www.scc.com/our-isv-programme/isvs/nqc/

Value Chain



Source
Value Chain, http://valuechain.com/

Pilot Approach Conclusions

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- The functionality of both pilot solutions is very similar and there is scope to work with both companies to add specific functionality.
- The price of both solutions is similar.
- NQC is the most likely choice for further work due to the track record in the UK government and specifically the work they have done on the Defence Cyber Protection Partnership (DCPP).

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Overall Conclusions

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- This study has shown that the risk in MOD's supply chain needs to be more proactively managed for the following reasons:

    1. **Risk is Evident**: Historical examples show that supply chain risks do manifest themselves in events which impact government defence agencies both financially and operationally. Case studies have indicated that there are high risk nodes in the MOD supply chain.
    2. **Risk is likely to Increase**: Supply chain risk is likely to increase in the future due to global warming, increasing global inequality leading to political instability, resource scarcity, growth of organised crime and the drive to find the lowest cost supplier anywhere in the world.
    3. **An Approach is Available**: There are simple and relatively inexpensive supply chain software tools which can be used to gather and analyse data from a large complex supply chain so that a variety of high risks can be identified, analysed and mitigated.

- For these reasons mapping and analysing risk in the MOD's supply chain is achievable and extremely important

Contact CORDA

If you would like to receive further information on CORDA's services, please e-mail corda.enquiries@corda.co.uk or alternatively ring the main CORDA number: +44 (0) 1252 383238.

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