Corporate Insider Threats – Perceptions on Scale and Risk, and Research Into New Detection Solutions

ICT Forum 2013 Conference, Professor Sadie Creese, July 11th 2013

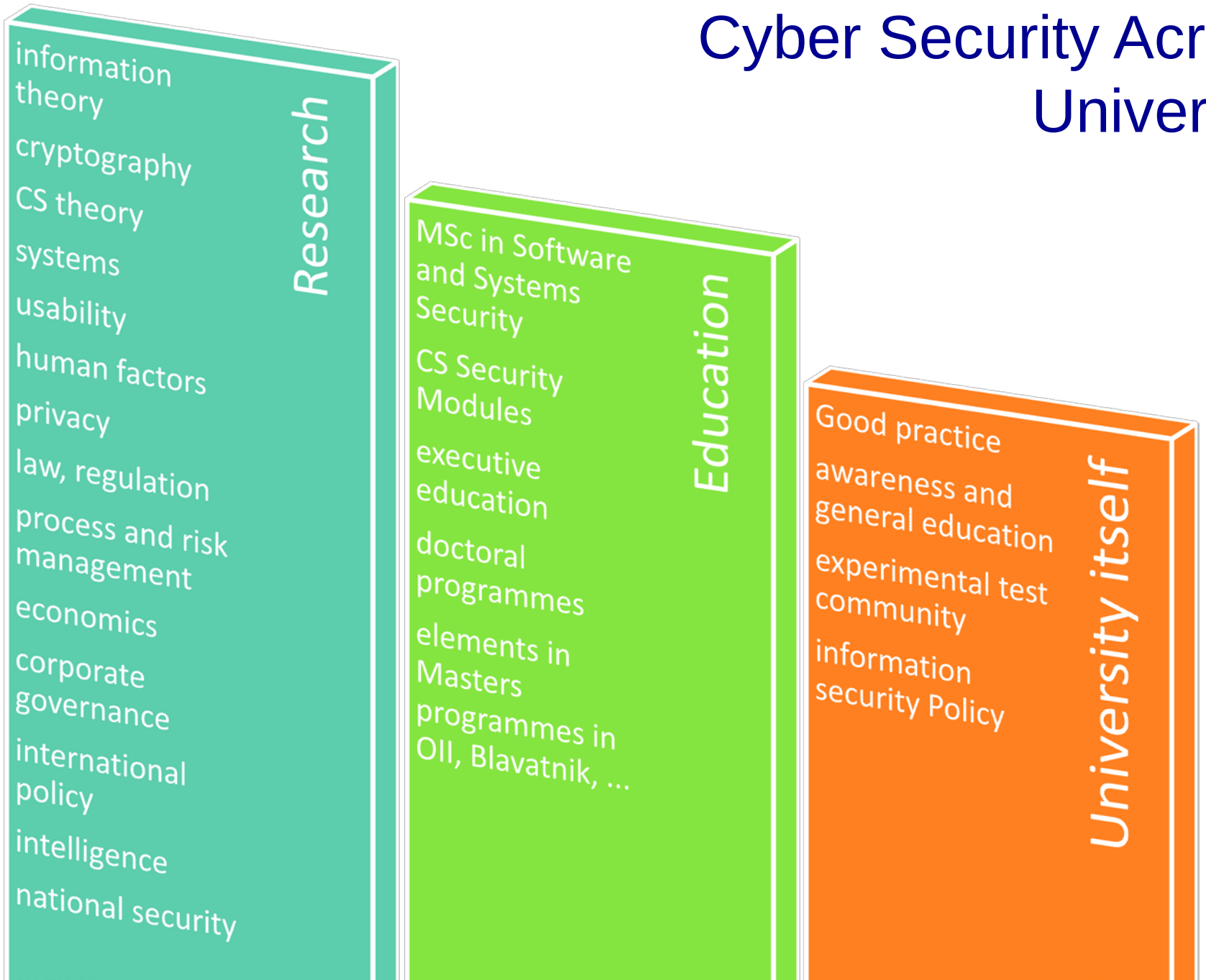
Michael Goldsmith (Oxford), Monica Whitty, (Leicester), Min Chen (Oxford), David Upton (Oxford), Michael Levi (Cardiff), Phil Legg (Oxford), Eamon Mcquire (Oxford), Jason Nurse (Oxford), Jassim Happa (Oxford), Nick Moffat (Oxford), Ioannis Agrafiotis (Oxford), Gordon Wright (Leiceser)

INSIDERTHREAT

But first……

INSIDERTHREAT

Cyber Security Across University



CYBER SECURITY CENTRE

UNIVERSITY OF OXFORD

Oxford Intern
Saïd Business
Oxford Martin
Oxford e-Rese
IT Services
Computer Sci
Blavatnik Sch

Research

Education

University itself

Academic Centres of Excellence in Cyber Security Research

GCHQ-EPSRC sponsored programme; modelled on a large, established scheme in the USA.

Review process: assessment based on research portfolio, doctoral programme, staff profile, vision and plans

Eight centres recognised in 2012; three more in 2013

Oxford, Bristol, Royal Holloway, Imperial, UCL, Southampton, QUB, Lancaster, Cambridge, Birmingham, Newcastle

GCHQ

EPSRC

Engineering and Physical Sciences Research Council

Global Centre for Cyber Security Capacity-Building

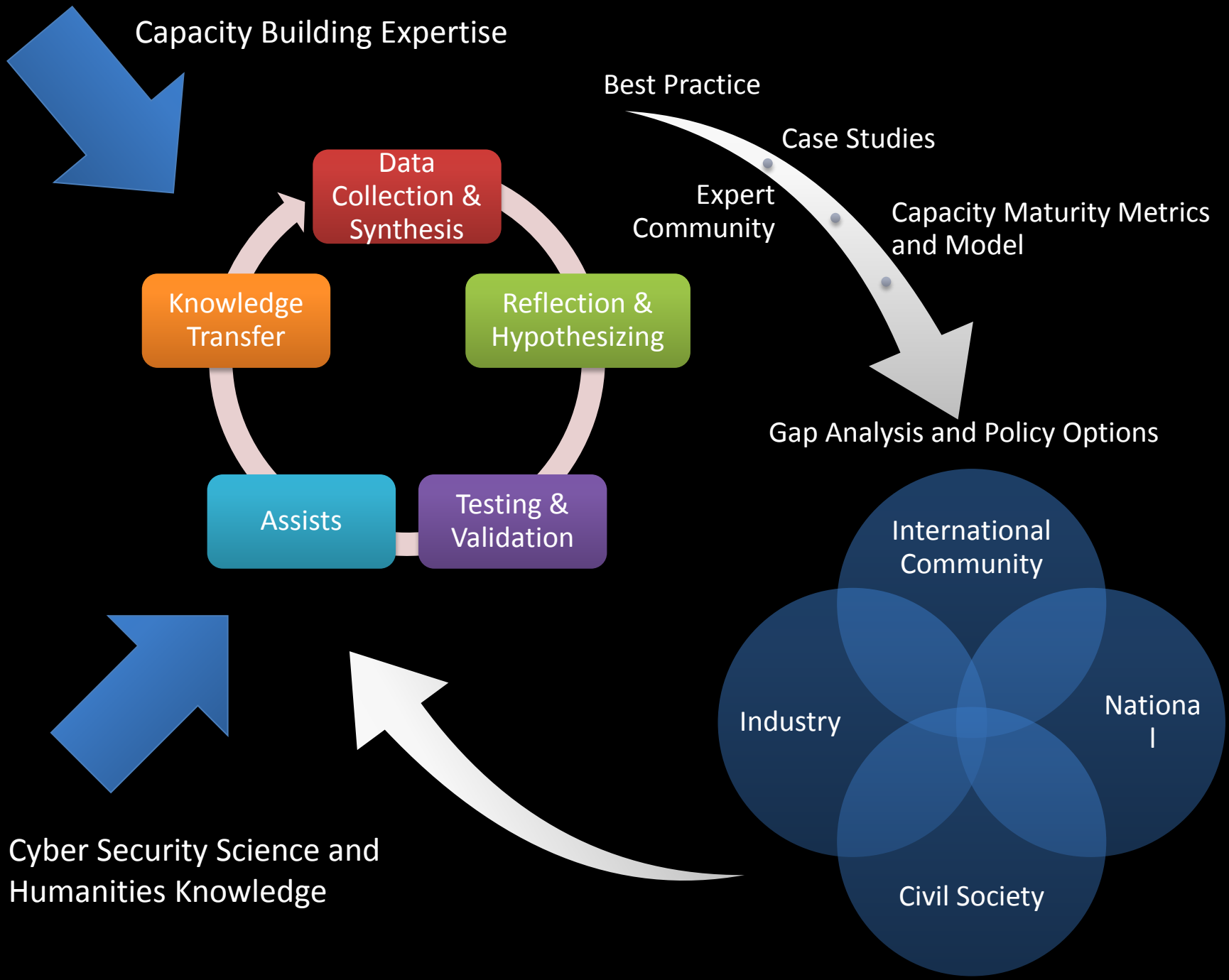
- Our aim is to understand **how to deliver effective cyber security** both within the UK and internationally. We will make this knowledge available to governments, communities and organisations to **underpin the increase of their capacity** in ways appropriate to ensuring a cyber space which can continue to grow and innovate in support of well-being, human rights and prosperity for all.

Foreign & Commonwealth Office

OXFORD MARTIN SCHOOL

UNIVERSITY OF OXFORD

Global Centre for Cyber Security Capacity-Building


Capacity Building Expertise
Best Practice
Case Studies
Expert Community
Capacity Maturity Metrics and Model
Data Collection & Synthesis
Reflection & Hypothesizing
Testing & Validation
Assists
Knowledge Transfer
Gap Analysis and Policy Options
International Community
Industry
National
Civil Society
Cyber Security Science and Humanities Knowledge

CENTRE FOR DOCTORAL TRAINING *in* CYBER SECURITY

UNIVERSITY OF OXFORD

new model of PhD/DPhil

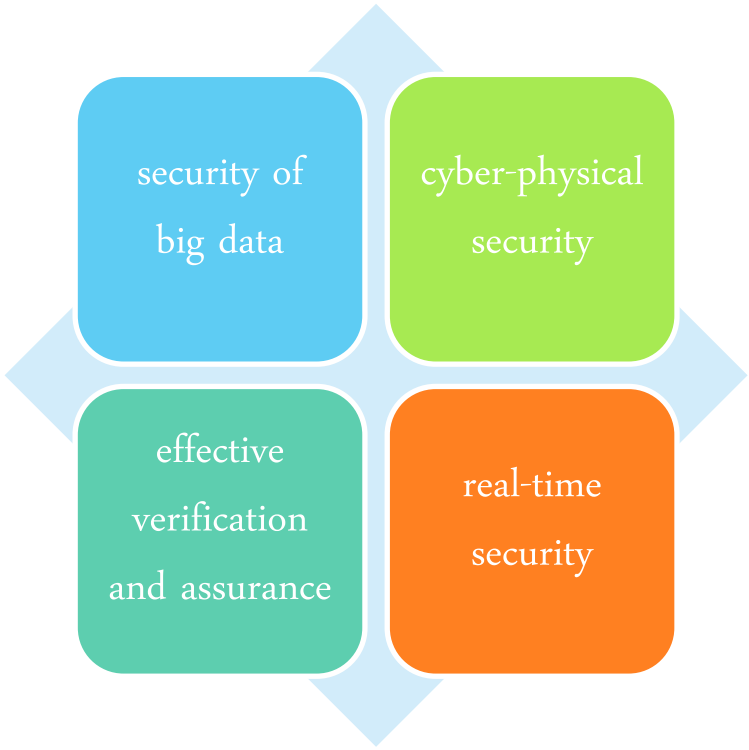
- promoted and funded by research councils
- £3.6m grant; 12 funded places per year; 3 annual intakes

year one:

- intensive education in cyber security
- two mini-projects (internships encouraged)
- seminars, industry 'deep dives', field trips

years two–four:

- research in an Oxford academic department
- skills training throughout
- retain contacts with internship companies



EPSRC Engineering and Physical Sciences Research Council

BIS Department for Business Innovation & Skills

And back……

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Part 1 – Overview of Technical Approach

What is Insider Threat?

An employee, affiliate or entity (person or not) of an enterprise with legitimate credentials who deliberately or unknowingly poses a risk to the enterprise it is tied to wholly or partially.

An insider threat is [posed by] an individual with privileges who misuses them or whose access results in misuse [Hunker 2011].

A *malicious insider* is a current or former employee, contractor, or other business partner who has or had authorized access to an organization's network, system, or data and intentionally exceeded or misused that access in a manner that negatively affected the confidentiality, integrity, or availability of the organization's information or information systems [Cappelli 2009].

The insider threat refers to harmful acts that trusted individuals might carry out; for example, something that causes harm to the organization, or an unauthorized act that benefits the individual [Greitzer 2012].

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Aims and Objectives

- **Aim:** To deliver a significantly enhanced capability for insider threat detection.

- **Objective**: To provide an all-encompassing approach on both the detection system required, and the contributing factors that impact on insider threat detection from related disciplines.

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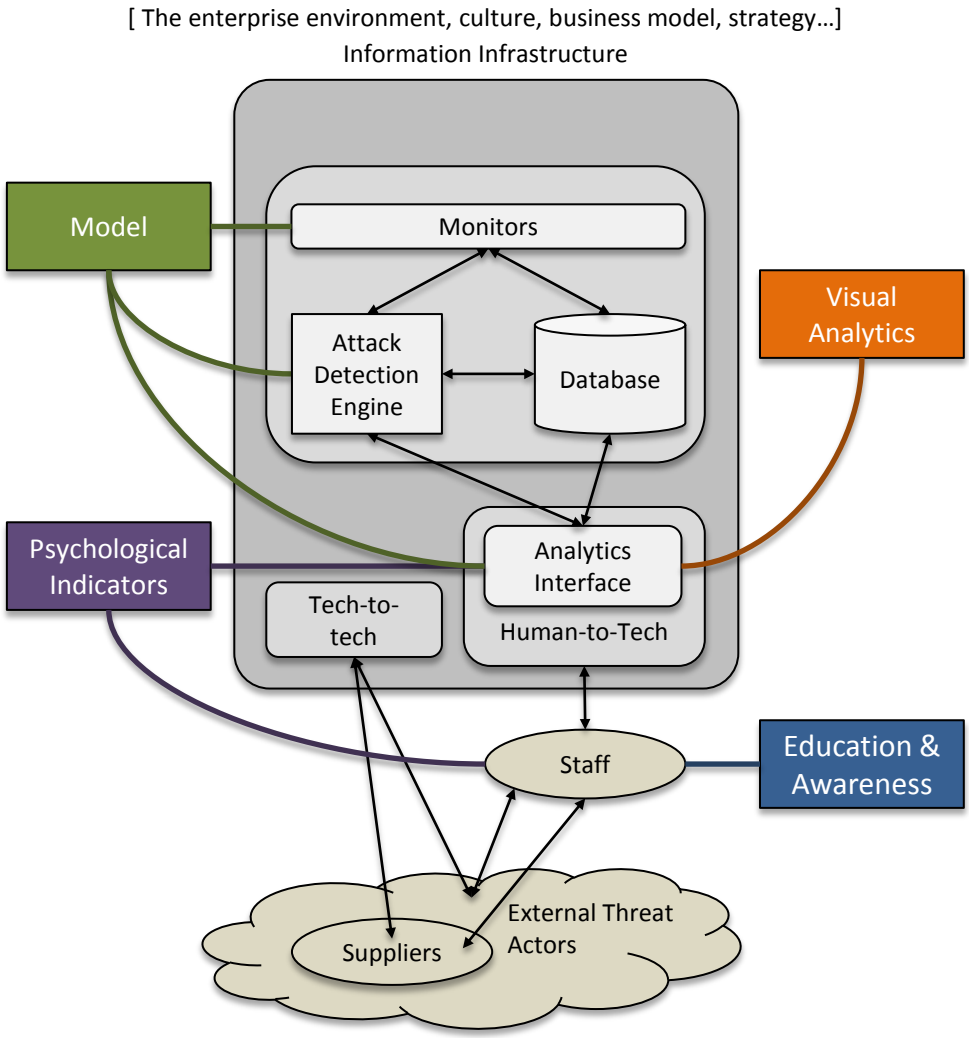
Approach Summary

- Conceptual model -> computational model for insider threat and detection
- Psychological indicators
- Pattern extraction, correlation and mining algorithms
- Enterprise culture and common practices, operational issues
- Visual analytics interface to support human understanding
- Education and awareness tools



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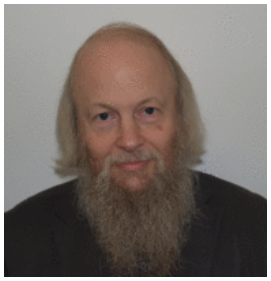
Lead Investigators

- Professor Sadie Creese
  - *Cybersecurity, University of Oxford*
- Professor Michael Goldsmith
  - *Cybersecurity, University of Oxford*
- Professor David Upton
  - *Operations Management, University Oxford*
- Professor Min Chen
  - *Visual Analytics, University of Oxford*
- Professor Monica Whitty
  - *Contemporary Media and Cyber- Psychology, University of Leicester*
- Professor Michael Levi
  - *Criminology, Cardiff University*



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Project Outputs

- **Survey** that captures the **current perception and practice** for insider threat detection within organisations.
- **Prototype detection system** that can alert of malicious employee activity and misuse in near real-time based on both observable patterns and cyber-psychological behaviours.
- **Visual analytics interface** for analyst exploration of organisation and employee alerts and activities.
- Education and raising awareness of insider threat through white paper publications and **teaching materials**.
- Contribution to recognised standards for future IDS systems.

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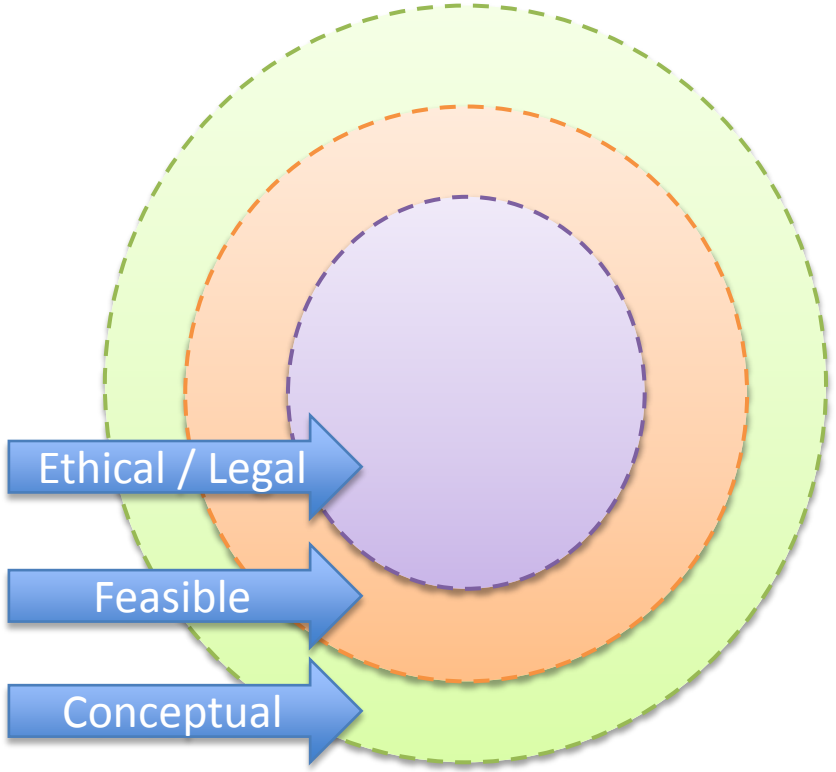
Modeling Approach

- Conceptual
  - What is the scope of information that could possibly be collected?
- Feasible
  - What is actually feasible to collect?
  - E.g., How would one quantify employee mentality or disgruntlement?
- Ethical / Legal
  - What is ethically feasible to collect?
  - E.g., Social media monitoring may be a breach of privacy.



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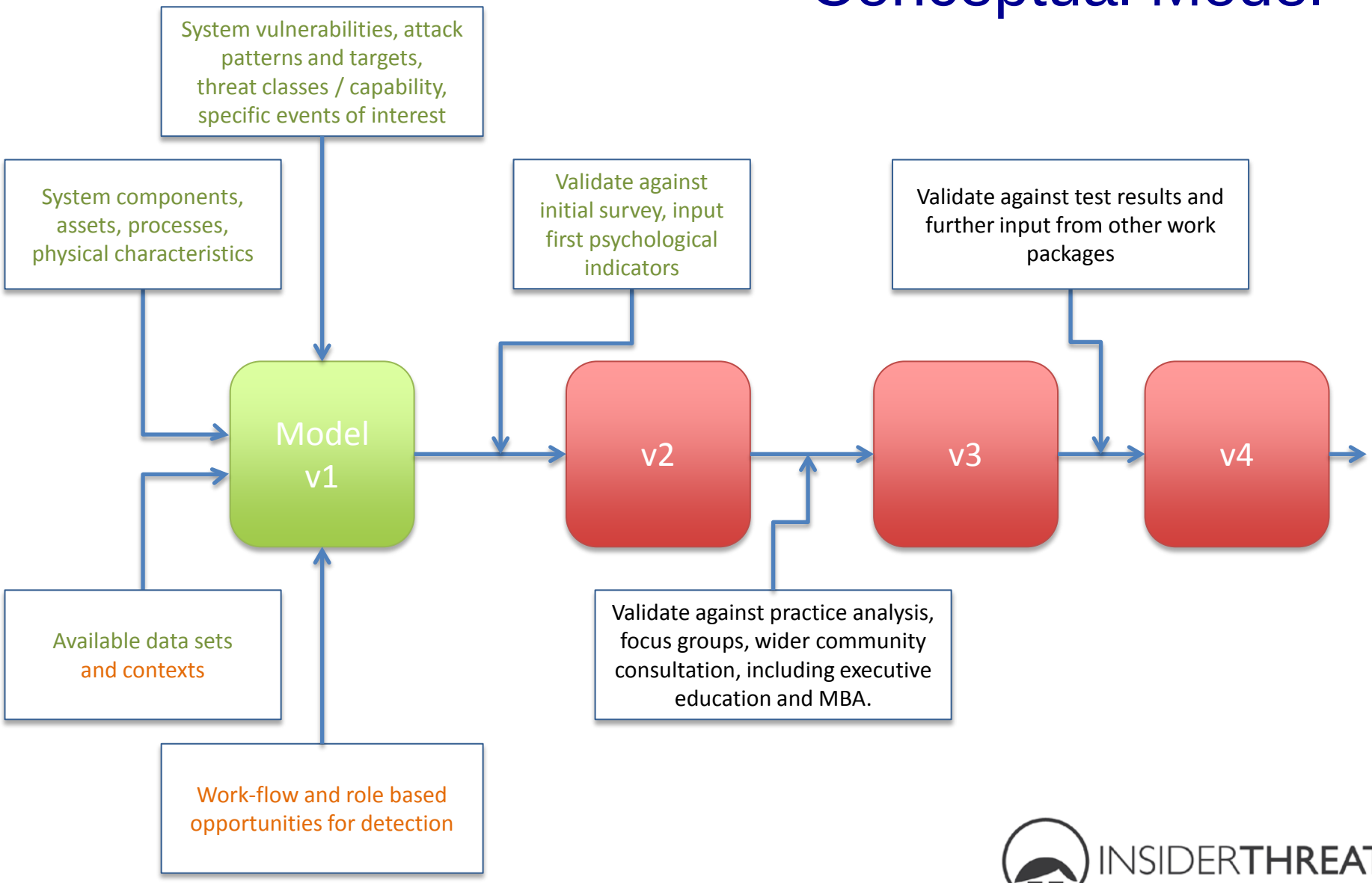
Conceptual Model



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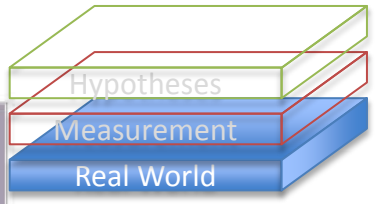

Enterprise

Opponents
Competitors: Companies, Nations
Activists
Mission

'Informers'
Law Enforcement
Government
Media
Clients / Customers

IP Agreement
Time since (re)issue
Effectiveness

Assets
Profit
Business Processes
IP
Services Provided
Staff
Property
Reputation

Business Threat Posed by Insider

People

Other Insiders' Actions

Outsiders' Actions

Social Engineering

Suspicious behaviour
Combativeness with Supervisor/colleagues
Outside interests
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Wrongdoing
Addictions
Debt
Over-inquisitive

Personal details
Remuneration
HR / Management Indicators
Memberships / qualifications
Sanctions*
Performance
Unmet expectation
Dissatisfaction
Concerning behaviour*

Bragging
Theft: Data, Financial
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Attack Incentives
Inform Other Attacks
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Offline Assessment of Potential Harm to Organisation

Current/Planned Work
Memberships / Interests
Social Network Activities
His External Profile

Insider(s)

Workload

Susceptibility to Coercion
Goals
Plans
Allegiences
Risk Appetite
His Mindset
Security Posture
Mental Stability
Motives

Attack Disincentives
Effort
Risks
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His Prohibited / Dangerous Behaviour

His Resources
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His Intrinsic Capabilities
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His Roles

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Routine Planned
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His Behavior
Normal
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Malicious

INSIDER RISK

Policy

Remedies

HR / Management Indicators *Sanctions
- Warnings
- Demotions
- Termination

HR / Management Indicators *Concerning behaviours
- Complaints / grievances
- Threats against organisation or people
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- Arrests
- Rule breaking / security violations
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- Rebelliousness
- 'Difficult to manage'
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Technology and Information

Senstive data
File Systems
Malware
Monitored Comms.
Servers
Clients: physical/ virtual/ limited

Historical Activity
Activity Logs
Current Activity

Patching
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Kill Chain Status

Fully/Partially Matched Attack Patterns
Methods
Affected Items (Files / Services)
Resources
Capability Gain / CIA Consequences
Match Status
System Prerequisities
Skills
Knowledge

Technical Threat Posed by Insider

System Config

Standards/DBs: CWE, CVE, CAPEC, ...

Personal Storage
Personal Comms
Personal Computers

Monitored Comms.
- Telephone
- MAC/IP Address (static/DHCP)
- Net access (fixed/WAP)
- Authentication
- Email
- Web pages (DNS/direct)
- FTP
- Chat
- Remote clients
- Shareport
- News feeds
- IM
- Facebook / Twitter

Physical

Access Control
Locations
Passes
Connections
Circumventions
Obstacles
Sensors

Location Statuses
Sites
Terminals
Buildings
Printers
Rooms

Physical Destruction
Physical Sabotage
Conventional Bomb
Suicide Bomb

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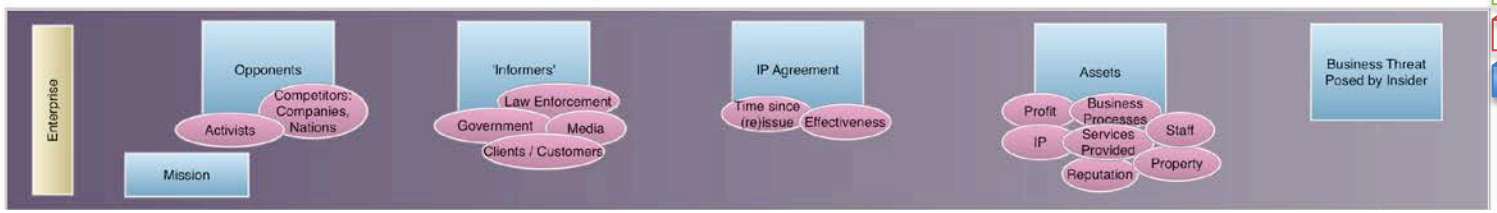

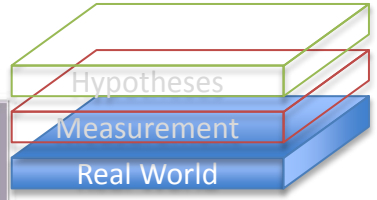

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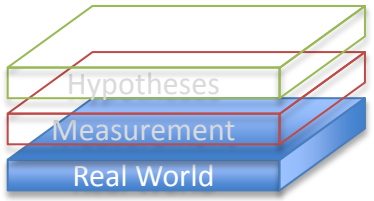

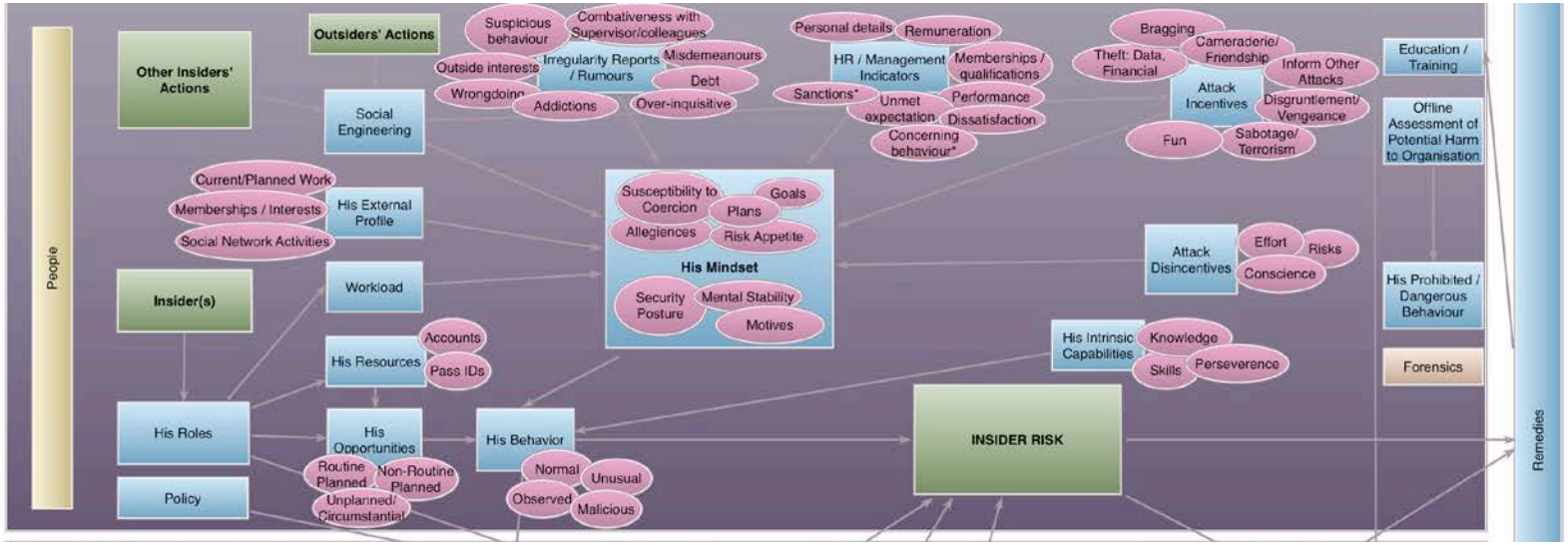

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- Warnings
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- 'Difficult to manage'
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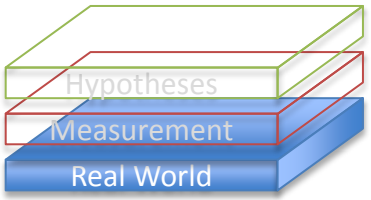

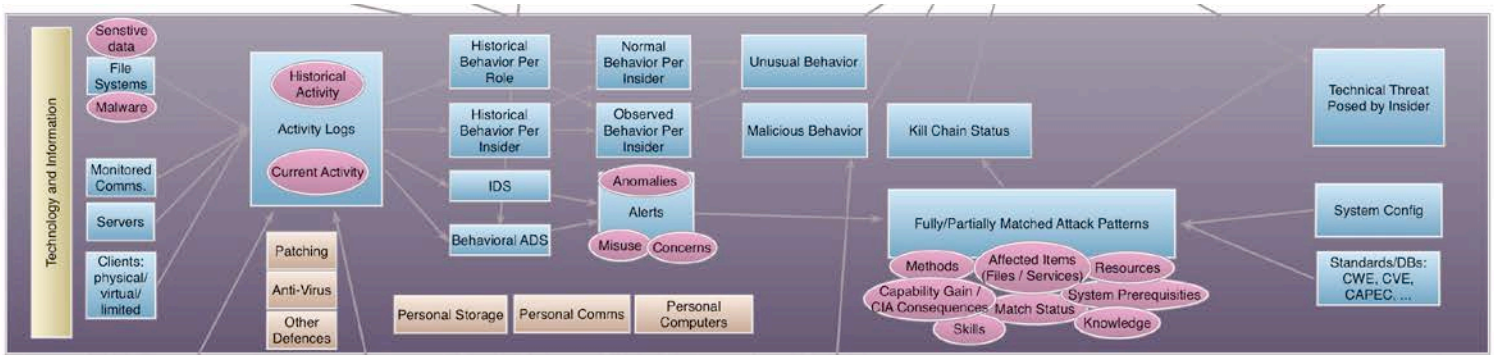

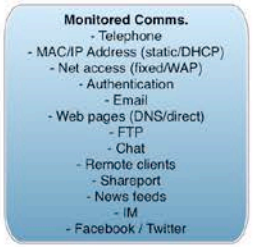

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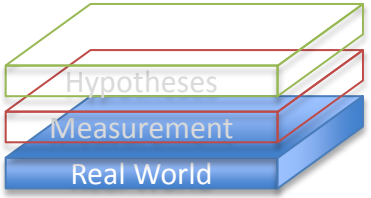

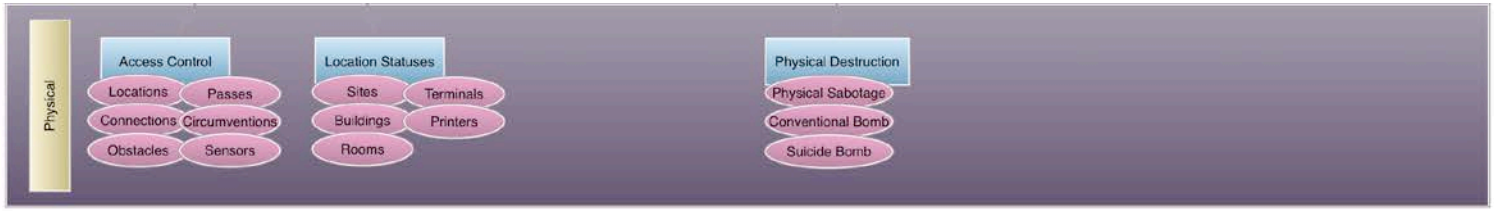

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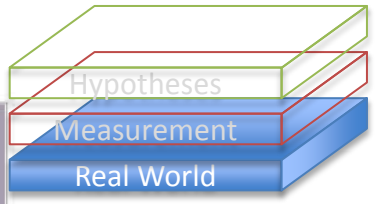

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Obstacles
Sensors

Location Statuses
Sites
Terminals
Buildings
Printers
Rooms

Physical Destruction
Physical Sabotage
Conventional Bomb
Suicide Bomb

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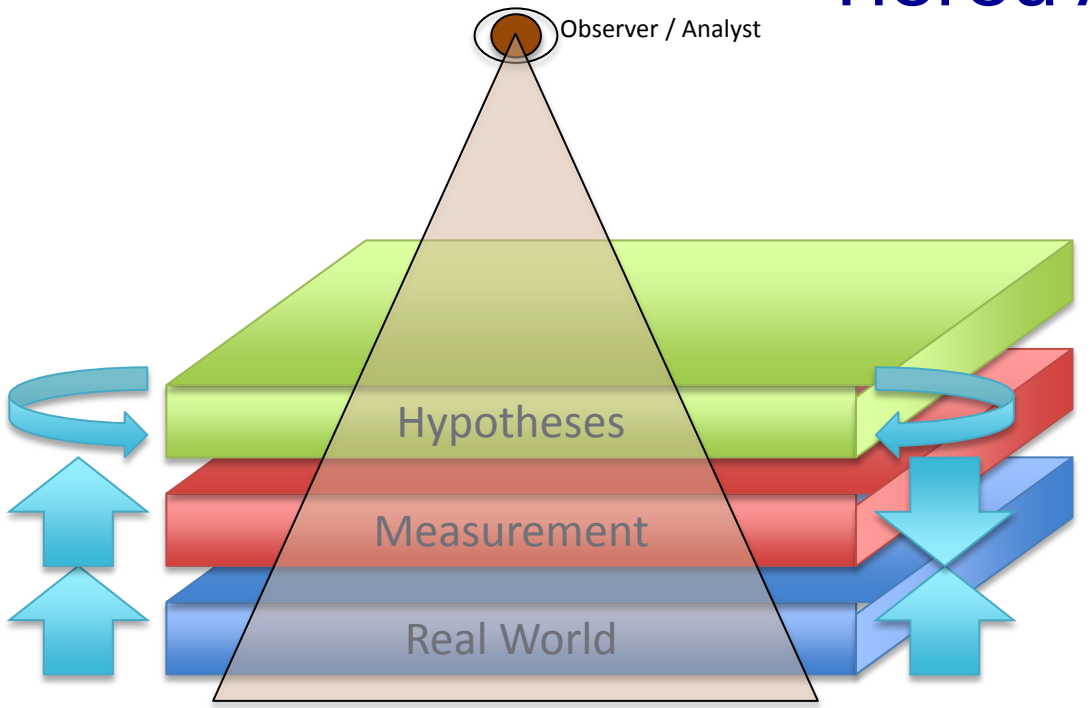
Tiered Approach



- Bottom-up approach
  - The system detects anomaly and alerts to the user.
  - Deviations from normal behaviour may indicate suspicious activity.
  - Need to manage false positives/false negatives rates generated by system.
  - Machine learning / data mining techniques.
- Top-down approach
  - Suspicions may arise from observed behaviour.
  - The analyst can investigate recent activity to identify anomalous behaviour.
  - Visual Analytics interface facilitates human understanding of large data.

Part 2 – Early Findings

Survey of Protective Monitoring Practices

Purpose:
Preliminary analysis of common protective monitoring and detection practices in corporate environments, to then feed into wider research tasks.

Literature:
Review of openly published reports from a range of sources revealed three key areas: Level and Nature of Insider Attack, Views on Risk, Detection Practice.

Study:
Conducted a pilot study with 48 participants to discover initial impressions of insider threats in organisations.

Future:
Full scale survey (>1000 participants) to be conclude early 2014.

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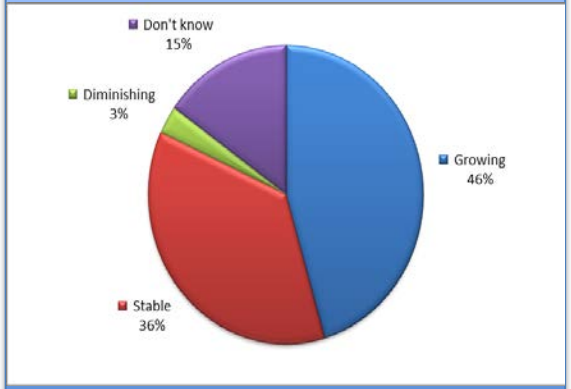
Highlights from Published Reports

Level and Nature of Insider Attack	Views on Risk	Detection Practice
Insider attacks are a significant proportion of the attacks faced by companies. Well-defined and prevalent types of attacks. Nature and potential for insider attacks expanded due to new technologies. Corporations still lack appropriate measures for the new risks.	Companies continue to underestimate insider threats. Lack of formal reviews, spending on security, and awareness of the issues. Cost of trade secret thefts exceeds $250 million per year, predicted to double over the next decade. Ford Motor Company had an employee steal trade secrets valued at in excess of $50 million.	A variety of approaches proposed, e.g. monitoring suspicious behaviour, establishing a baseline of normal. Currently many insider incidents are detected by non-technical means. Growing popularity in the use of automated tools to help manage insider risk, e.g., Enterprise Fraud Management (EFM) solutions

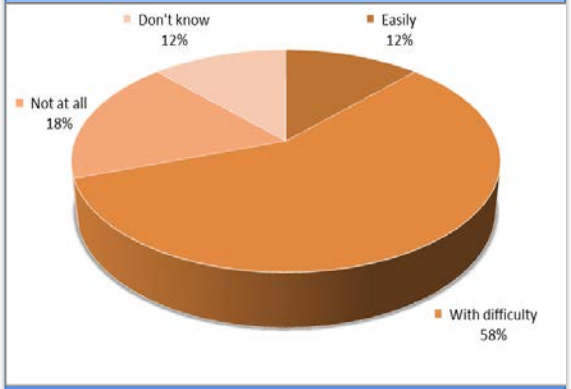
Highlights from Web-based Survey

Do you think that the threat from insiders is growing or diminishing?



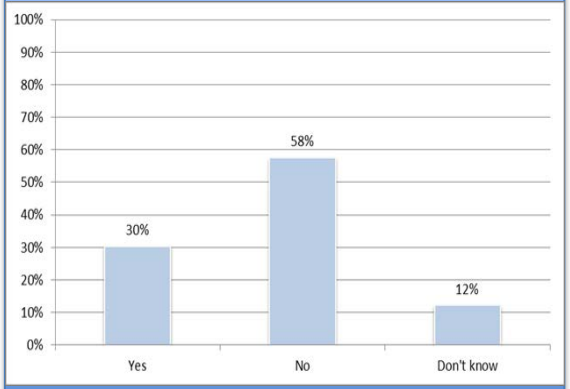
Almost half of the respondents felt that the threat from insiders was growing.

Please describe the extent to which you can predict insider threats before they conduct attacks.



This is an important question that validates the aim of the overall project. 76% of managers said that they were only able to predict an insider attack with difficulty or not at all.

Is insider-threat detection an important part of your organisation's culture?



A strong majority say that insider threat detection was not part of the culture. This suggests that there may be cultural challenges in changing both attitudes and behaviour on the topic.

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Interim Conclusions

Climate and perception of risk	Insider attacks are rising, consequences are potentially more significant, under-reported.
Insider detection practice	View of the community: some best practice in place but more can certainly be done to improve detection.
Management levels of concern	Poor education on the topic. Highlights the importance of awareness and education needs.

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Focus groups & Case Studies

- Considering how the acts took place
- Type of person/personality
- Social/psychological background
- Motivation of staff
- How they were caught out
- What could have been done better in hindsight

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Example 1

- Male security
- Stealing data using KVM
- At work or left overnight
- Psychological background: extremely nervous behaviour
- Motivation: money

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Example 2

- Male, long term employed (20 years)
- Psychological background: long-term aggressive behavior
- Organisational background: passed from manager to manager; prior to fraud given a written warning for fraud with respect to claims for times/expenses
- After the fraud: discovered long telephone calls to sex lines; breached security
- Attack: fraud: large sums of money, faked hospital letter
- Motivation: disgruntled employee; weak social identity with organisation;
- Detected: fellow workers reported odd behaviour

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Example 3

- Male, security; access to most of building
- Psychological background: Asperger's
- Breached security online by creating a replica of the building within second life – which caused problems with security of the building.
- Logged on at work at odd hours.

Immediate Future Cases

- Professional Sporting Organisation – IP theft and receipt
- Global Telecoms Infrastructure – IP theft
- Global Logistics – systems corruption / theft of physical assets
- Cloud Disaster Recovery – systems corruption / Denial of Service
- Financial Sector – more than just fraud

Potential new Cyber-indicators

- Stress
- Change in mood
- Personality (e.g., dark triad)
- Impulsivity
- Change in online behaviours
- Social network information (e.g., bragging; excessive money spent on holidays).

Underpinning the Education

- Investigating Cyber Risk communication within MBA environment
- Strong interest in ‘sexy’ attack / threat material
- Less interest in defence considerations
- => need to adapt message and materials accordingly
- Next steps: bespoke insider sessions and teaching case studies

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Statistical Profiling

- Observed data to be incorporated into network through statistical profiling.
  - Time-based, frequency-based, and pattern-based profiles of employees.

Example Video for Time-based profiling Top: Current observed activity. Middle: Cumulative observed profile. Bottom: Normal profile. Left-to-right: Login, Logout, Duration, Removable Device, Email, Web. *User does not normally use a removable device. However, observed profile shows early morning activity of login, removable device usage, and web activity.*	

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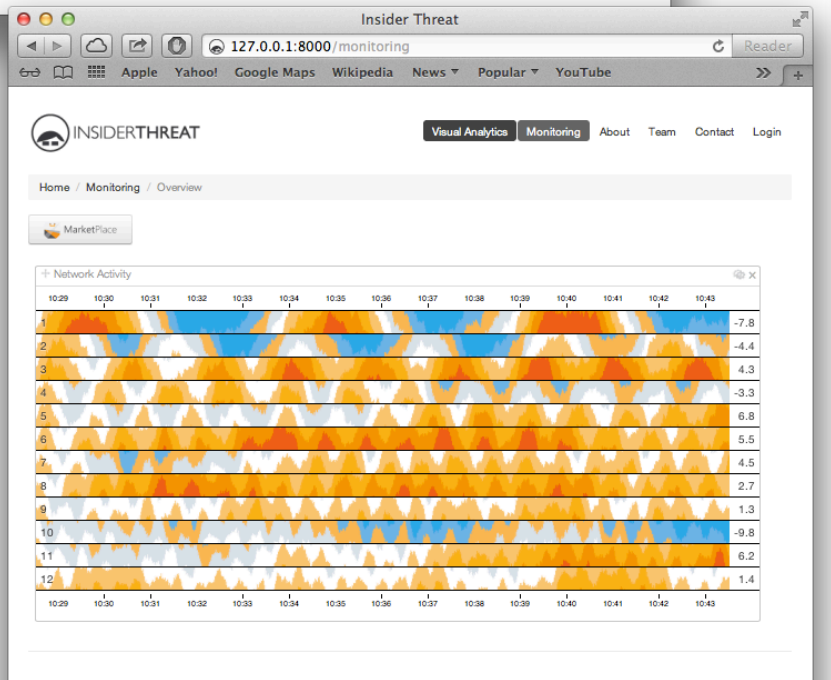
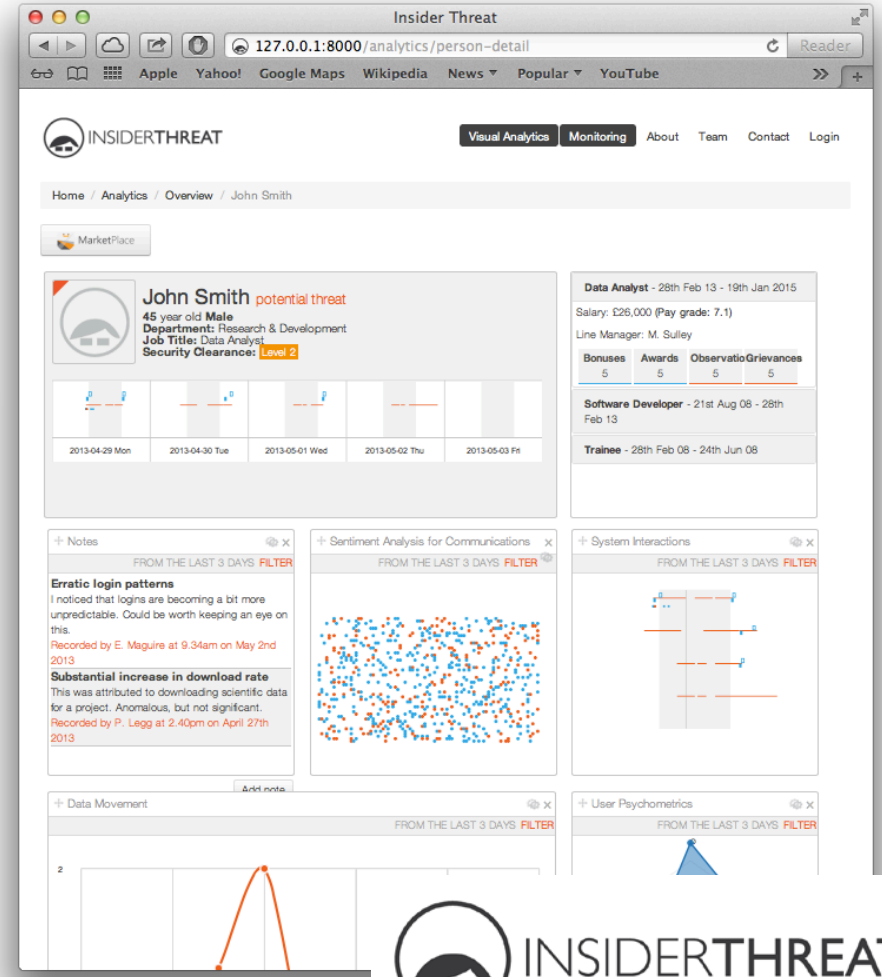
Visual Analytics Interface





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Thank you for listening.

Questions?


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