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Mapping the consensual knowledge of security risk management experts

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Abstract

The security industry comprises of diverse and multi-disciplined practitioners, originating from many disciplines. It has been suggested that the industry has an undefined knowledge structure, although security experts contain a rich knowledge structure. There has also been limited research mapping security expert knowledge structure, reducing the ability of tertiary educators to provide industry focused teaching and learning. The study utilized multidimensional scaling (MDS) and expert interviews to map the consensual knowledge structure of security experts in their understanding of security risk. Security risk concepts were extracted and critiqued from West Australian university courses. Linguistic analysis categorised the more utilized security risk concepts. MDS tested these concepts and presented a spatial knowledge structure [STRESS1=0.35, α=0.64], further tested and validated by security experts [N=3]. The study presented a number of significant findings. A table of security categories, with supporting subordinate concepts was presented. The security risk consensual knowledge map suggested that the concept threat occupied a central theme for security experts. Spatial location of security risk concepts provided an indication of conceptual relationships. Finally, the sequential structure and concept clusters provided an indication of security expert conceptual decision making.

Key words
Security, risk, concept mapping, multidimensional scaling

INTRODUCTION

The security industry comprises of diverse and multi-disciplined practitioners, originating from many disciplines. The industry has an undefined knowledge structure, although security experts contain a rich knowledge structure (Smith, 2001). This diversity of skills and knowledge makes it difficult to provide effective and appropriate tertiary education to the security industry. There has been limited research mapping security expert knowledge structure, further reducing the ability of tertiary educators to provide industry focused teaching and learning.

BACKGROUND

World exposure to terrorist attacks in London (2005), Jakarta (2004), Russia (2004), Spain (2004), Bali (2002) and New York (9,11) has raised social concern over the ability of governments to protection its citizens. An address by Prime Minister Mr. John Howard on Australian national security stated that the Bali attacks had touched all Australians, resulting in the federal government committing AUS$3.1 billion in additional funding to deal with the terrorist threat. The financial impact of the 11th September 2001 cost the United States 0.75 percent of US GDP or US$75 billion (Howard, 2004). In Europe a billion Euro coherent strategy is being developed to coordinate military and civilian research in security related projects (Horvath, 2004). These issues have raised both national and international requirement for tertiary trained security practitioners (School of Engineering and Mathematics, 2004).

In the United States alone there are 10,000 security companies who employ 1.8 million guards. This statistic equates to almost three private security officers to every public officer and this is expected to increase (Hemmens, Maahs, Scarborough & Collins, 2001). The resulting paradigm shift is merging the distinction between these traditionally distinct entities of public police and private security (Fergusion, 2004; Morley & Vogel, 1993). But the security industry is a diverse and a specialty industry that has a requirement for both generic and domain specific skills (Hesse & Smith, 2001; Manunta, 1996) and being a relatively young and emerging discipline, continues to expand (Fischer & Green, 2004; Tate, 1997). However, this expansion has resulted in limited tertiary education programs and research to determine the knowledge structure of security.

SIGNIFICANCE OF THE STUDY

Security may be considered assured freedom from poverty or want, precautions taken to ensure against theft, espionage, or a person or thing that secures or guarantees (Angus & Roberston, 1992). According to Fischer and Green (2004, p. 21) "security implies a stable, relatively predictable environment in which an individual or group may pursue its ends without disruption or harm and without fear of such disturbance or injury." But security may be expanded to consider national security and the defence of a nation, though armed force or the use of force to control a state's citizens. Security may also imply public policing, with state employed public servants. Still others may consider security as crime prevention, security technology, risk management or loss prevention. This diversity results in a society that has no clear understanding of what security is, but has divergence of interests from many stakeholders (Manunta, 1999).

A traditional definition of security is the provision of private services in the protection of people, information and assets for individual safety or community wellness (Craighead, 2003). Private or commercial security may be considered the provision of paid services in preventing undesirable, unauthorized or detrimental loss of an organizations assets (Post & Kingsbury, 1991). But security may present very different meaning to different people (Davidson, 2005, p. 72), given time, place and context. It has been suggested that security has to have a shared definition among many disciplines, that this is essential and urgent (Manunta, 1999). But the current international fight against terrorism and related threats has shifted security into an ambiguous arena (Horvath, 2004), where security is presented within many diverse domains.

It has been argued that security lacks definition (Tate, 1997) and therefore lacks structured knowledge. But this should not lead to a conclusion that security does not contain a defined knowledge structure. Other disciplines are poorly structured, but experts have still developed and defined abstract interpretation (Zeitz, 1997). The diversity and cross-disciplined nature of security will change as the discipline becomes more *professional*, concepts are developed and defined, and tertiary education increases to support the discipline. It is also argued that a rich knowledge structure has been developed with security experts, which can be extracted and defined as a *consensus* model (Smith, 2001).

There has been a demand for appropriate security education since the 1950's (Fischer & Green, 2004). In a West Australian Department of Training report into the training needs of the security industry, Tate (1997, p. 2) raised a number of key findings regarding the educational needs of the industry. These included restricted government occupation classification, no national peak association, limited career structure, fragmented education and no independent academic discipline. But security education has an excellent future considering the indicated growth (Fischer & Green, 2004), although according to Manunta (1999, p. 57) *academia* is content to continue to discuss security without definition. Without a concise understanding of security, how can educators develop appropriate programs and curriculum in security science education?

PURPOSE OF THE STUDY

The purpose of the study was to ascertain the knowledge construct of *security risk*, with the research questions being:

- What are the knowledge categories and subordinate concepts of security science?

- What is the expert knowledge structure and subordinate concepts of security risk management, as measured by multidimensional scaling?
- What is the expert knowledge structure and subordinate concepts of security risk management, as measured by interviews?
- Can a security risk management *consensual* map be developed and presented?

A number of significant outcomes from the study were expected. These outcomes included a better understanding of the security risk management knowledge structure, tabulated in a security risk management knowledge category with subordinate concepts. Once the concepts were defined, a security risk management *consensual* map could be developed and presented. This knowledge structure understanding could allow further development and definition of security science education and curriculum design, particularly in security risk management. These aspects will support the emerging domain of security science.

THEORETICAL FRAMEWORK

The theoretical foundation presents the scientific structure of the study, which included knowledge structure, concept mapping and multidimensional scaling (MDS). Knowledge included cognitive memory, knowledge categorisation and expertise. Concept mapping and MDS supported the development of security knowledge categorisation and subordinate concept modelling.

Knowledge and Categorisation

Angus and Robertson define knowledge as "facts or experiences known by a person or group of people … specific information about a subject" (1992, p. 557). But according to Clancey knowledge "is more than written scientific facts and theories." (1997, p. 285). Knowledge is not discovered, but utilizes and expands existing concepts (Novak & Gowin, 1984) and is "a possible state of affairs either real or imaginary" (Eysenck & Keane, 2002). As new knowledge is gained, change in understanding regarding existing knowledge is achieved. Knowledge is *viable* (Rennie & Gribble, 1999), constructed and built on previous known knowledge.

Knowledge is integral to memory structure, which may be defined as the way in which memory is organized, stores and retrieves information. The memory process has a major impact on the ability of long term memory (LTM) to retain and retrieve (Eysenck & Keane, 2002) and is a complex interactive process (Lockhart & Craik, 1990), which requires knowledge categorisation.

As a person is exposed to a large quantity of information in their everyday life, knowledge has to be economized and abstracted into categories, generally referred to as *concepts*. These are developed and maintained within LTM, but there is a cognitive balance between the number and effectiveness of possible concepts. Concepts need to be *informative*, based on the natural world, economic, cohesive and categorized. There are four theories for concept categorisation, being the *defining-attribute*, *prototype*, *explanation* and *exemplar-based* views (Eysenck & Keane, 2002). The exemplar based view was considered the informing theory supporting knowledge categorisation.

Concept Mapping

Concept maps may be defined as a representation of a state of affair or situation. People may attempt to understand the world through developing a concept map of the situation, an idea, understanding or principle. Concept maps are thinking tools to explore different aspects of a topic (Wallace, Schirato & Bright, 1999), are imaged, dynamic and outcome based simulations that are utilized in everyday life to think and understand the world (Eysenck & Keane, 2002; Johnson-Laird, 1983; Norman, 1983). Concept maps enable people to exchange an idea, have shared understanding, provide common language, reach conclusion in decision making and guide their action (Norman, 1983; Novak & Gowin, 1984).

Concept maps attempt to present many aspects of human cognition, from direct representation of a physical entity to abstract thought. This supports understanding of a concept, because once a person understands the physical process most will accept a formal model (Bar & Travis, 1991). Representation of abstract thought is far less defined and involves implicit knowledge, but these models will "represent aspects of external reality" (Borges & Gilbert, 1999, p. 96). Experts tend to define their knowledge within concept clusters, which are more extensive, have greater cross concept linkage, increased branches, greater hierarchical structure and are more complex (Markham, Mintzes & Jones, 1994).

There are many methods to develop concept maps, with an enormity of variations that may extract, develop and represent concept maps (Ruiz-Primo, Schultz, Li & Shavelson, 2001). The study utilized both quantitative and qualitative techniques to extract and define the concept map of security risk.

Multidimensional Scaling

MDS is a statistical technique within the area of multivariate data analysis. MDS reduces complex *n* dimensional data and presents these data as a spatial representation. The reduction in data complexity through presentation in *n* dimensional space allows hidden data structure formation. This demonstrates object proximity, with *proximity* being how similar or dissimilar objects are perceived to be (Cox & Cox, 2000; Kruskal & Wish, 1978). MDS commences with a set of objects, which are paired and their similarities measured. The distances between pairs of objects are placed in a half matrix format. Configurations of points are sought in *n* dimensional space, with each point representing an object. MDS calculates *n* dimensional space configuration where the points distance *match* the paired dissimilarities. The variation in *matching* defines the different techniques of MDS (Cox & Cox, 2000), with the study utilizing the ALSCAL algorithm:

$$\delta_{re} = \left\{ \sum_{i} (x_{ri} - x_{si})^2 \right\}^{1/2}$$

MDS provided a suitable tool (Smith, 2003) to categorize knowledge concept clusters within *n* dimensions. This method is supported by Ohanian (cited in Stein, 1997), whom stated that expertise can be measured as a construct that contains multiple dimensions. MDS facilitated the construction of the security *consensual* map. MDS produced a spatial representation of knowledge concept clusters, allowing an analysis of judgements between variables to define dimensionality between such variables (Cohen, Manion & Morrison, 2002). MDS also provides a moderate to good construct validity for concept mapping (Hoz, Bowman & Chacham, 1997, p. 928).

SECURITY RISK MANAGEMENT

The study was divided into four distinct phases, with phase one knowledge categorisation commencing the study. West Australian tertiary undergraduate security courses were investigated and critiqued, with initial course selection based on course title. Supported by both industry and academic security experts (N=3), further analysis reduced the number of courses to three for content analysis. Course structures were analysed and security concepts extracted. Concept extraction utilized Linguistic Inquiry and Word Count (LIWC) text and content analysis (Pennebaker, Francis & Booth, 2001).

Once the final courses (N=3) were selected for content analysis, course syllabi were sourced. Course syllabi included the course overview, and unit of study descriptions, objectives and content overview.

Concept extraction commenced with an initial analysis of each critiqued course. Course transcripts were sanitised, as generic study or research skills were not considered within the content analysis. Course title analysis provided the initial concept categorisation, although only the security risk management category was considered further. Analysis resulted in a final *security risk management* category, with supporting subordinate concepts (table 1).

Table 1 Risk management category and subordinate concepts

	Security risk management	
Analysis	Intelligence	Risk
Communications	Judgement	Risk management
Consequence	Model	Statistics
Cultural risk	Probability	Threat
Decision making	Perception	

The second phase utilized phase one data (table 1) to analyse the data (α0.64) using MDS. MDS ALSCAL analysis (STRESS1=0.35, RSQ=0.27) produced the spatial map (figure 1), which required rotation and insertion of propositional statements. This enhancement resulted in the presentation of a draft consensual map of security risk.

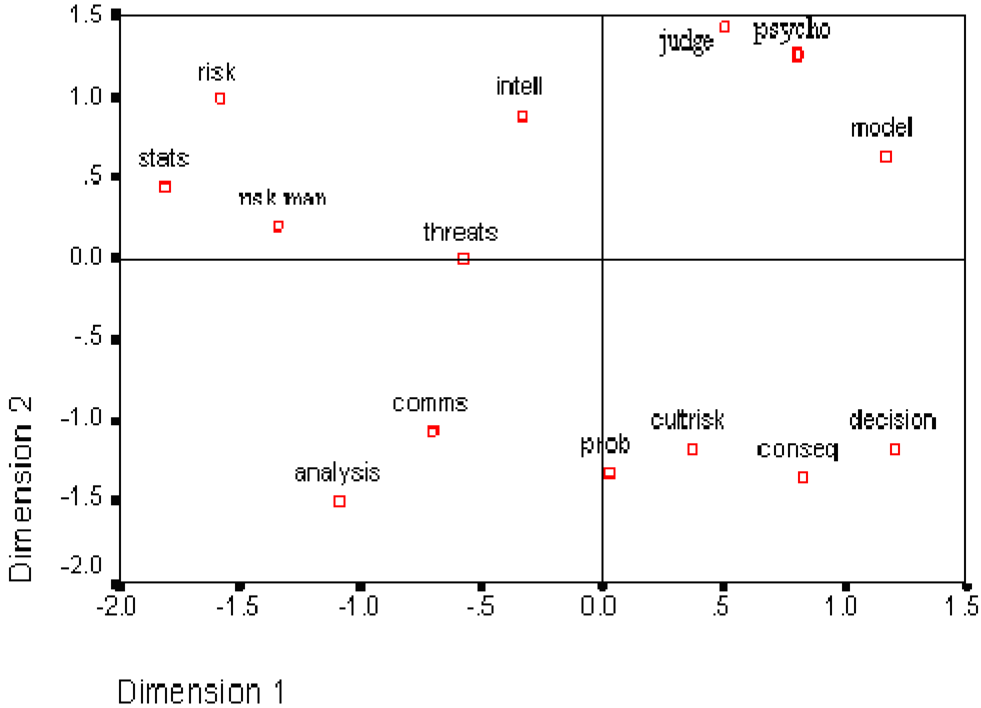

Figure 1. MDS consensual map of security risk. (comms = communications; cultrisk = cultural risk; intell = intelligence; psycho = perception; stats = statistics)

Phase three utilized expert interview case studies (N=2) of the *draft risk management consensual* map. An expert interview survey instrument was developed to analyse and interpret the opinions of both experts regarding the knowledge category *risk management*, subordinate concepts and *risk management consensual* map structure. To complete the study a comparative stage to triangulate (Cohen, et al., 2002, pp. 112-115) between phases two and three outcomes followed. This phase defined and quantified the appropriateness of the MDS developed security risk management consensual map.

MAPPING SECURITY RISK MANAGEMENT

The survey data were analysed, with interpretations resulting in a number of significant findings. These findings included the ability of MDS to present a consensus knowledge map, tabulated security risk management category and supporting subordinate concepts (table 1) and a consensual map of security risk management (figure 2).

The *consensual risk* map structure, spatial representation, sequential nature of concepts and the inclusion of the most significant security risk concepts provided evidence that the *consensual risk management* map appeared to represent an appropriate knowledge structure for the security category of *risk management*. This structure was strongly supported by both security experts.

It also appeared that the *consensual risk management* map presented an appropriate sequential representation of subordinate concepts. This sequence was demonstrated through the agreement of both experts in the significant relationship of many *risk* concepts, with a core representation being; *risk, threat, consequence* and *decision.* But errors were also demonstrated in the map, which showed how spatial separate demonstrated weak conceptual linkage. It appeared that the sequential nature of the majority of subordinate concepts based on spatial proximity demonstrated expert decision making. Both experts indicated that there could be many more possible linkages and relationships within the consensus map. Although both experts considered that the map represented the category *risk management*, there was greater complexity than shown within the map.

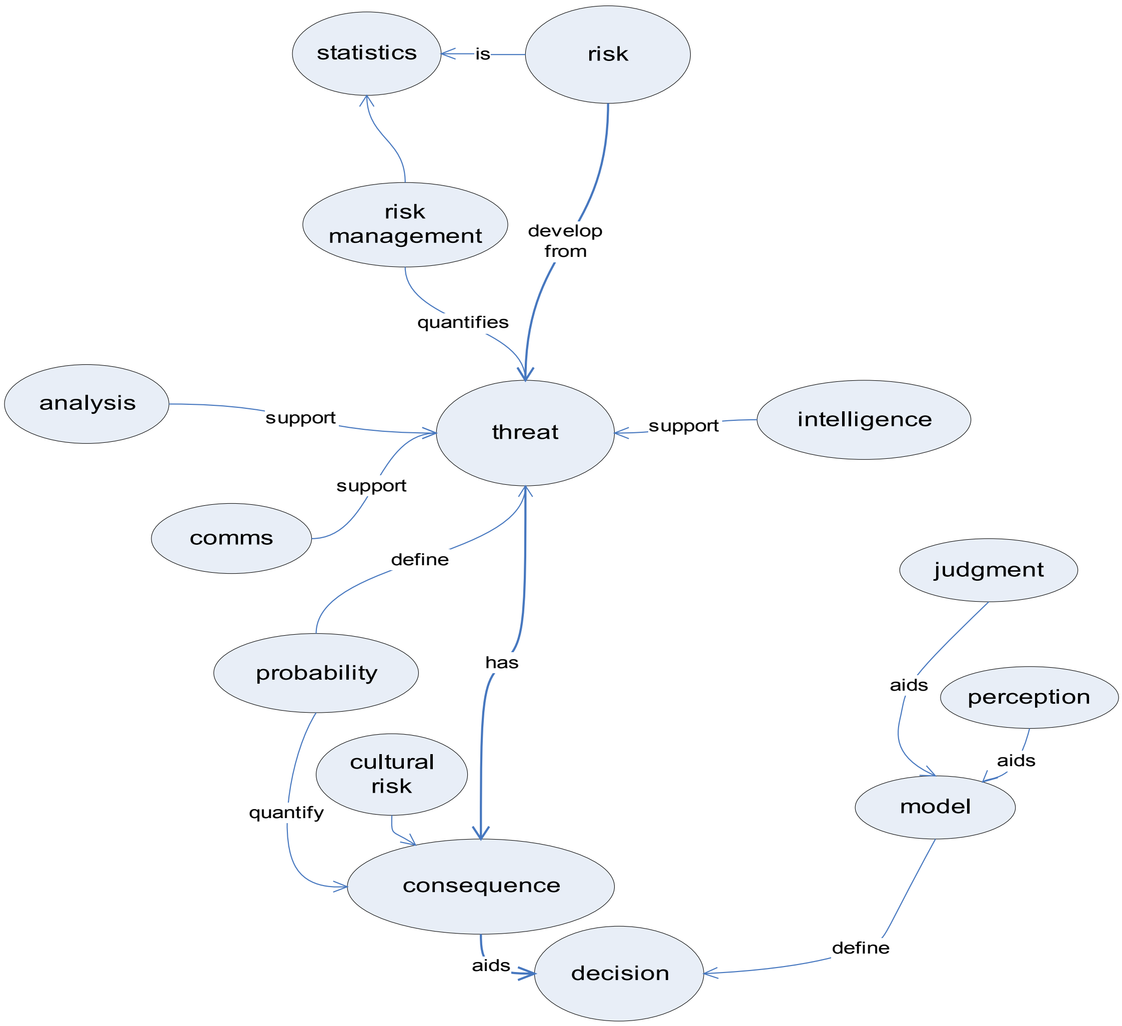

Figure 2. Consensual map of security risk management. Notes: 1. Final map has been spatially altered to allow insertion into the paper 2. comms = communications; decision = decision making

The study appeared to demonstrate a number of significant findings. These support the research questions and evidence suggests that for the security risk management category:

- MDS represented an appropriate technique to provide structure in the foundation of consensual knowledge maps.
- Within the MDS consensual knowledge map, the spatial location of concepts provided an indication of conceptual relationship.
- Within the MDS consensual knowledge map, the sequential structure and concept clusters provided an indication of expert conceptual decision making.
- Propositional links can be inserted based on the spatial proximity of concepts.
- Propositional statements based on spatial proximity, although important in aiding map comprehension, cannot be labelled through the MDS technique.
- Propositional statements require consensual expert input.
- An appropriate consensual map of the security risk category and supporting subordinate concepts was presented (figure 2).

STUDY PROGRESSION

The research has been expanded to investigate and critiqued international tertiary undergraduate security courses (N=104). Appropriate courses (N=7) have been selected for content analysis, with full course structures and unit outlines sourced. A table of security categories (N=14) have been defined and include; criminology, emergency/contingency planning, facility management, fire science, industrial security, information and computer security, investigations, physical security, principles, risk management, security law, security management, technology and threats. A list of supporting subordinate security concepts (N=2001) has also produced, but due to the size of this list not tabulated within relevant security categories.

LIMITATIONS OF THE STUDY

Four limitations need to be addressed with the study. The first was the small sample size (N=3) of the study, although this is currently being rectified with a significantly larger follow up study. The second consideration was the method to construct and insert propositional linkages and supporting statements into the map, which produced greater discussion with the experts than the consensual risk map structure. Future studies should utilize domain experts to develop, insert and support propositional linkages and supporting statements.

The third consideration was phase two concurrent Pearson validity mean measure, producing a moderate to low (r=40, SD0.13) result. This measure indicated that the participants produced different responses within the phase two instrument, although this did not appear to be reflected in the consensual risk management map and later phase triangulation. Finally, the MDS consensual map of security *risk* produced a high (STRESS1=0.35, RSQ=0.27) measure.

CONCLUSION

The study presented a consensual map of security risk management, with supporting subordinate concepts. Evidence from the study appeared to indicate that MDS represented an appropriate technique to provide structure in the foundation of consensual knowledge maps and that the spatial location of concepts provided an indication of conceptual relationship. The consensual risk management map presented a central concept of *threat*, indicated sequential expert decision making, showed concept clusters and provided a list of security risk subordinate concepts.

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