

5-2018

## A Knowledge Management Approach to Identify Victims of Human Sex Trafficking

Marisa Hultgren  
*San Diego State University*

Jessica Whitney  
*San Diego State University*

Murray E. Jennex  
*San Diego State University, murphjen@aol.com*

Aaron Elkins  
*San Diego State University*

Follow this and additional works at: <http://aisel.aisnet.org/cais>

---

### Recommended Citation

Hultgren, Marisa; Whitney, Jessica; Jennex, Murray E.; and Elkins, Aaron (2018) "A Knowledge Management Approach to Identify Victims of Human Sex Trafficking," *Communications of the Association for Information Systems*: Vol. 42 , Article 23.

DOI: 10.17705/1CAIS.04223

Available at: <http://aisel.aisnet.org/cais/vol42/iss1/23>

This material is brought to you by the AIS Journals at AIS Electronic Library (AISeL). It has been accepted for inclusion in Communications of the Association for Information Systems by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact [elibrary@aisnet.org](mailto:elibrary@aisnet.org).



## A Knowledge Management Approach to Identify Victims of Human Sex Trafficking

**Marisa Hultgren**

Homeland Security Department,  
San Diego State University

**Jessica Whitney**

Fowler College of Business  
San Diego State University

**Murray E. Jennex**

Management Information Systems Department  
Fowler College of Business  
San Diego State University  
*murphjen@aol.com*

**Aaron Elkins**

Management Information Systems Department  
Fowler College of Business  
San Diego State University

### Abstract:

Social media and the interactive Web have enabled human traffickers to lure victims and then sell them faster and in greater safety than ever before. However, these same tools have also enabled investigators in their search for victims and criminals. We used system development action research methodology to create and apply a prototype designed to identify victims of human sex trafficking by analyzing online ads. The prototype used a knowledge management approach of generating actionable intelligence by applying a set of strong filters based on an ontology to identify potential victims. We used the prototype to analyze a data set generated from online ads. We used the results of this process to generate a revised prototype that included the use of machine learning and text mining enhancements. We used the revised prototype to identify potential victims in a second data set. The results of applying the prototypes suggest a viable approach to identifying victims of human sex trafficking in online ads.

**Keywords:** Human Sex Trafficking, Knowledge Management, Ontology.

This manuscript underwent editorial review. It was received 07/10/2016 and was with the authors for 17 months for 2 revisions. Chelley Vician served as Associate Editor.

## 1 Introduction

Trafficking humans for sexual exploitation is one of the fastest-growing criminal enterprises even though international law and the laws of 158 countries criminalize sex trafficking (Equality Now, 2017). The Equality Now (2017) *Sex Trafficking Fact Sheet* lists these statistics:

- Sex trafficking is a lucrative industry that makes an estimated US\$99 billion a year.
- At least 20.9 million adults and children are bought and sold worldwide into commercial sexual servitude, forced labor, and bonded labor.
- About two million children are exploited every year in the global commercial sex trade.
- Approximately 54 percent of victims are trafficked for sexual exploitation.
- Women and girls make up 96 percent of victims of trafficking for sexual exploitation.

Further, human trafficking is not just a third or developing world problem. The National Human Trafficking Resource Center hotline lists 1654 human trafficking cases reported in the United States (of which 1220 were sex trafficking) during the first quarter of 2016 (through 31 March, 2016) (NHTRC, 2016). Additionally, the National Human Trafficking Resource Center has reported that California had 305 of these 1,654 cases; in the state, three out of every 1,000 people were in some form of forced labor, including the forced sex trade, in the first quarter of 2016 (NHTRC, 2015).

The U.S. Government defines human trafficking as inducing others to perform a commercial sex act by force, fraud, or coercion; as inducing a person under 18 years of age for such an act; and/or as recruiting, harboring, transporting, providing, obtaining a person for labor or services through the use of force, fraud, or coercion in order to subject them to involuntary servitude, peonage, debt bondage, or slavery (National Institute of Justice, 2012). However, the Department of Homeland Security (DHS) has more recently shortened the definition of human trafficking to a contemporary form of slavery that involves the illegal trade of people for exploitation or commercial gain (Department of Homeland Security, 2014). Further clarifying this definition, California's Department of Justice (DOJ) has stated that human trafficking is a contemporary form of slavery that involves controlling a person through force, fraud, or coercion to exploit the victim for forced labor, sexual exploitation, or both (Harris, 2012). While slightly different, all three definitions are similar in context. However, for this paper, we use California's DOJ's definition but note that two classes of human sex trafficking exist: those for victims under 18 (minors) and those for 18 or over.

In this paper, we focus on the sex trafficking aspect of human trafficking and propose an information systems approach to identify sex trafficking victims based on analyzing online (Internet) ads. We focus on online ads because social media and the interactive Web have enabled traffickers to lure victims and sell them at a faster rate and in greater safety than ever before. However, these same tools have also created new avenues for prosecution and criminal investigations for law enforcement as officials now have access to a vast amount of information about the sex industry. We use system development methodology from action research (Nunamaker, Chen, & Purdin, 1990; Burstein & Gregor, 1999) with a knowledge management strategy approach of identifying actionable intelligence (i.e., identifying victims of human sex trafficking) by applying a set of strong filters based on an ontology of keywords that codifies attributes of human sex trafficking victims to assess an unstructured data set consisting of the text from online ads scraped from the women looking for men section of backpage.com.

Specifically, we address the following research question:

**RQ:** Can one use online data to identify victims of human sex trafficking?

To answer this question, we created a prototype to explore text-based indicators of human trafficking in online classified ads. In particular, we created the prototype to:

- Create an ontology/keyword list of terms and/or attributes that may indicate human trafficking
- Create a process for extracting an unstructured text data set from online advertising, and
- Use the keyword ontology to construct strong filters that can be applied to the unstructured data set to determine ads that create actionable intelligence on identifying victims of human sex trafficking.

The prototype we created comprised:

- Strong filters that comprised knowledge/experience-driven ontologies of keywords that modeled human sex trafficking victims
- A process for updating the ontology
- A process for extracting an unstructured data set of online ads, and
- A process for analyzing the unstructured data set using evaluation criteria for determining what ads are actionable

Technologies in the prototype included ontologies, machine learning, text mining, and Web scrapers.

## 2 Literature Review

### 2.1 Knowledge Management

We used a knowledge management approach to develop and apply ontologies to create strong filters to help identify potential victims of human sex trafficking in online advertising. In this section, we review the literature and theoretical base for using knowledge management to help develop a system implementation to assist in searching for human sex trafficking victims.

Davenport and Prusak (1998) view knowledge as an evolving mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. They found that, in organizations, knowledge is often embedded in documents or repositories and in organizational routines, processes, practices, and norms. They also say that, for knowledge to have value, it must include the human additions of context, culture, experience, and interpretation. Polanyi (1967) and Nonaka and Takeuchi (1995) describe two types of knowledge: tacit and explicit. Tacit knowledge (commonly known as unstructured knowledge) refers to knowledge that individuals understand in their minds and that data or knowledge representations cannot directly express. In contrast, explicit knowledge (commonly known as structured knowledge) refers to knowledge that that knowledge representations can directly express.

Jennex (2005) defines KM as the practice of selectively applying knowledge from previous decision making experiences to current and future decision making activities to improve an organization's effectiveness. Also, Jennex views a KM system (KMS) as a system created to help individuals and organizations capture, storage, retrieval, transfer, and reuse knowledge. Jennex (2005) perceives KM and KMS as ideally holistically combining organizational and technical solutions to retain and reuse knowledge and, thus, to improve organizational and individual decision making. This view coincides with Churchman's (1979) view of KM that allows KMS to take whatever form necessary to accomplish these goals. Holsapple and Joshi (2004) provide another key definition of KM: they consider it as an entity's systematic and deliberate efforts to expand, cultivate, and apply available knowledge in ways that add value to the entity in the sense that it creates positive results from accomplishing objectives or fulfilling its purpose. Finally, Alavi and Leidner (2001) conclude that KM involves distinct but interdependent processes of knowledge creation, knowledge storage and retrieval, knowledge transfer, and knowledge application.

Jennex (2017b) incorporates big data and the Internet of things (IoT) (see Figure 1 below) into Jennex and Bartczak's (2013) modified knowledge pyramid and uses the final revised pyramid to define the purpose of KM as identifying, generating, capturing, and using actionable intelligence. KM processes filter IoT, big data, data, information, and knowledge to generate specific, actionable intelligence that the organization can share with specific, limited users. Additionally, Jennex (2017b) places filters on social networks to limit access and to separate and capture that which the organization needs from that which it does not. In this vein, "filters" is a fairly new term for KM, and we view KM filters as the implementation of KM strategy. Figure 2 (Jennex, 2017a) shows the components necessary for successful KM. While KM requires all the components in the figure and we use them all in this research, we consider KM strategy and KM content the most important in designing and implementing the prototype that we present in this paper. KM strategy determined needed actionable intelligence, guided us in determining what data and information to collect, and finally guided us in designing and constructing the filters.

KM content (see Figure 2) is the process used in KM to ensure the KM system has captured the knowledge necessary to process data and information into actionable intelligence. We used the experiential knowledge that we present in Section 2.2 as the key knowledge applied in the prototype. Experiential knowledge refers to framed knowledge (in this paper, knowledge about sex trafficking victims)

that guided us to select and apply the right technologies and ontologies to create appropriate filters for processing the data and information that we gathered.

Ontologies codify knowledge by providing a simplified and explicit specification of a phenomenon that one desires to represent (Gruber, 1995). Ontologies are useful because they explicate components that define a phenomenon and, thus, can help in systematically understanding or modeling that phenomenon (Holsapple & Joshi, 2004). Keywords/terms are specific examples from an ontology with a complete set of keywords/terms that define an ontology.

Alavi and Leidner (2001, p. 114) define a KMS as “IT (Information Technology) based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application”. Many researchers include ontologies in the KMS as tools for organizing and retrieving knowledge (Holsapple & Joshi, 2004; Aldea et al., 2003; Jurisica, Mylopoulos, & Yu, 1999; Aldea et al., 2003; Varma, 2007; Almeida & Barbosa, 2009; Wu & Yang, 2005).

We created ontologies by identifying keywords from the experience literature that describes the phenomenon of human sex trafficking. We then used our first ontology in a KMS that applied the ontology to a set of unstructured ad data to create actionable intelligence that we could use to identify potential victims of human sex trafficking in online advertising. Subsequently, we created a new ontology based on more current literature and a second data set and then used machine learning tools to enhance this ontology based on patterns in the ad data set and applied the enhanced ontology to identify potential victims of human sex trafficking in the second data set. In the future, we plan to use machine learning tools to automatically generate an ontology from a new data set.

In Section 2.2, we present the experience literature that we used to create the initial ontology of indicators of potential human sex trafficking victims.

## 2.2 Indicators of Sex Trafficking in Ads

We reviewed the literature for research that focused on identifying victims of sex trafficking through indicators found in ads. We reviewed these indicators for those that we could operationalize through a set of key words/ontology. The below list and literature reflects those indicators that met this requirement.

### 2.2.1 Movement between Cities

Ads that evidence frequent movement, or transience, may signal that a sex worker is a victim of trafficking. Pimps often move victims around from city to city in order to avoid law enforcement and to maintain control by keeping victims from building a social support system or becoming too familiar with a particular area (Dank et al., 2014). This movement also keeps victims disoriented and ignorant of where to seek help (Harris, 2012). However, pimps tend to move victims in groups or stables. Ultimately, this steady movement leaves women and girls consistently vulnerable to those who control them. Indeed, a study on trafficking in Silicon Valley found that traffickers often move sex workers around the Bay Area (Juniper Networks, 2014). The frequent movement between cities also has a marketing side. It serves to maintain a “fresh” product line for clients (Harris, 2012). In this way, traffickers constantly circulate “new product” to entice consumers (Ibanez & Suthers, 2014). They often move international women from the East to the West Coast, South to Northeast, and from urban to rural and vice versa. American women are trafficked across city and state borders and internationally (Raymond, Hughes, & Gomez, 2001). Additionally, traffickers may post ads in other cities to gauge the market in that area based on the amount of hits they get (Dank et al., 2014). By analyzing phone numbers posted in ads, researchers can identify area code networks in online escort service ads that can further identify patterns of victim movement in a geographical area (Ibanez and Suthers, 2014).

### 2.2.2 Ethnicity and National Origin

Ibanez and Suthers (2014) reference the denotation of ethnicity as a possible sign of trafficking. One needs to use this indicator in context of the data set one analyzes before including it as an indicator to ensure that the data set uses a variety of ethnicities/national origins because an estimated 72 percent of sex trafficking victims in California are American citizens. Thus, being “American” is not effective as an ethnicity or national origin term for identifying a potential trafficking victim.

### 2.2.3 Restricted Movement

Law enforcement officials believe that pimps consider it safer to conduct activities online and use incalls only (Dank et al., 2014). Previous studies have used restricted movement seen through terms such as “incalls only” as a possible indicator of sex trafficking (Ibanez & Suthers, 2014). To control their victims, perpetrators often deny them their freedom of movement and keep them isolated.

### 2.2.4 Unconventional Sex

One ad that researchers found to advertise a victim of sex trafficking included the term “open minded” (Operation Broken Silence, 2012), which may be a code word that signifies that customers can perform unconventional and sadistic types of sex. As such, an ad with such a phrase may increase the likelihood that the sex worker it advertises is a victim of trafficking (Yen, 2008).

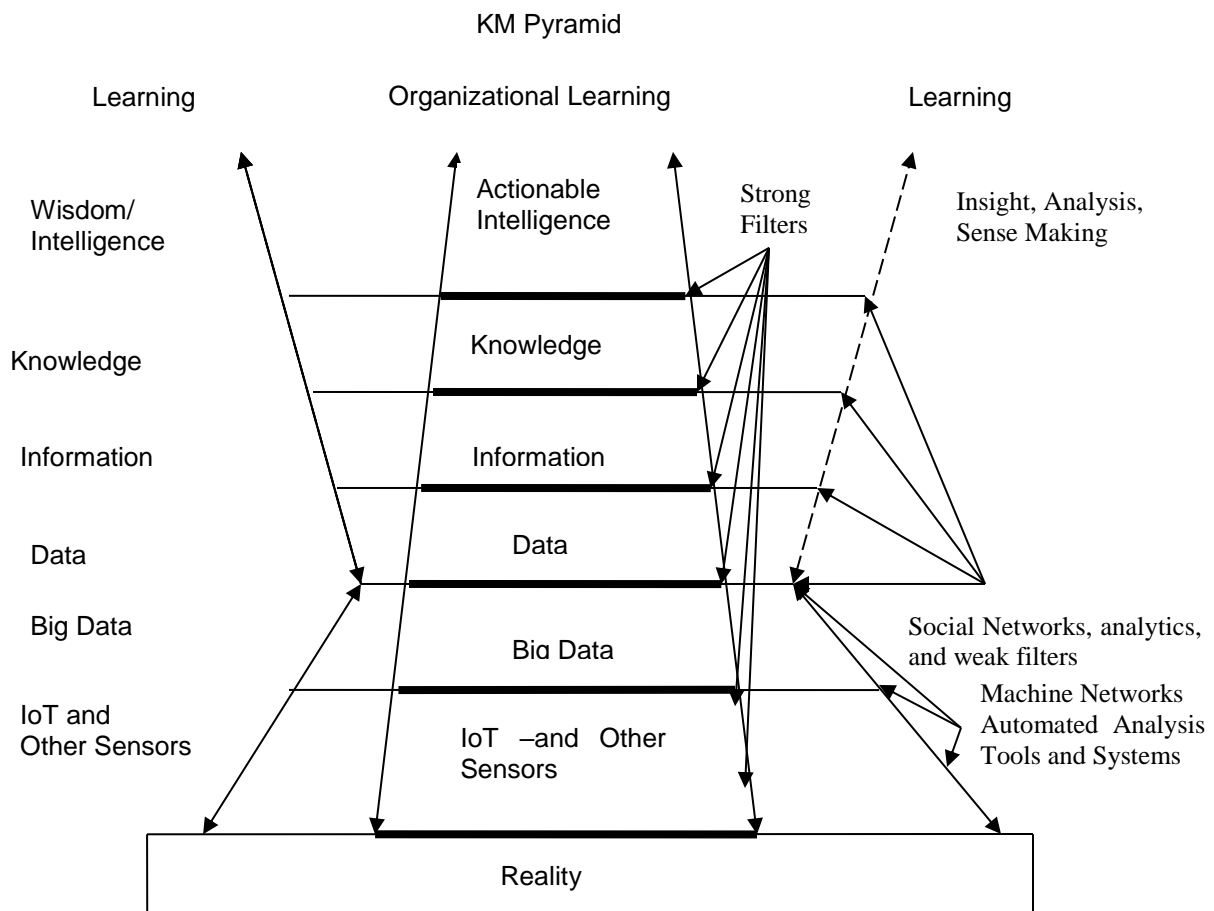


Figure 1. The Final Revised Knowledge Pyramid (Jennex, 2017b)

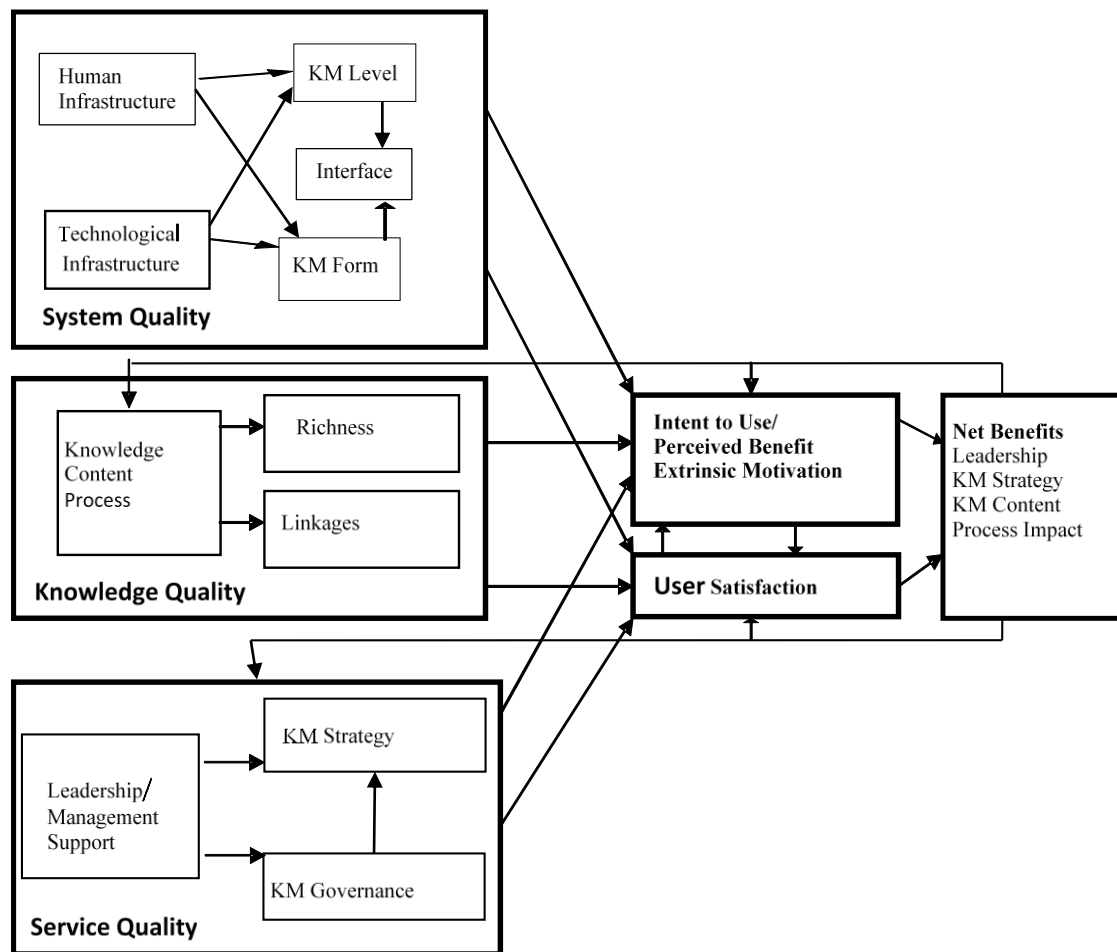


Figure 2. Revised Jennex-Olfman Success Model (Jennex, 2017a)

### 2.2.5 Minors Trafficked Online

Sellers solicit buyers who are interested in purchasing young girls (often minors) using certain keywords that can indicate a sex trafficking victim. Ads for underage victims sometimes use words such as: fresh, fresh meat, young, virgin, prime, coochie (shaved), non-pro, new, new in town, barely legal/18, college student/girl, lovely, daddy's little girl, sweet, 1986 Firebird, new in the life, liked girls, youthful, and fantasy (Bouche, 2015; Boyd, Casteel, Thakor, & Johnson, 2011; Major, 2012).

### 2.2.6 Phone Numbers and Area Codes

Classified ads often include phone numbers. Customers and sellers sometimes use them to look up reviews on a particular girl and to see if the girl has alternate names (Ibanez & Suthers, 2014). Traffickers and victims often use multiple (both contract and disposable) phones in sex trafficking operations. Latonero et al. (2012) looked at the distribution of phone numbers using a simple Google search and found the phone number of one suspected victim on seven other escort service websites for multiple cities. Additionally, they found the same phone number on MyRedBook with a different name but similar photographs. This widespread advertisement across the Internet and geographic regions indicates more than just alone prostitute out to make extra money. It could even indicate a sex trafficking ring. Information from area codes strongly indicates the movement of victims and traffickers. The area code network offers both a source and destination. One can generate maps to determine suspected routes that sex traffickers use to transport victims from one location to another.

### 3 Methodology

In this section, we describe the methods we used to perform this research.

#### 3.1 System Development Method

We used the systems development research methodology from action research that Nunnamaker et al. (1990) and Burstein and Gregor (1999) describe. We chose this methodology in order to produce a system that combines technology with social understanding for detecting ads that offer the services of victims of human sex trafficking. Figure 3 shows the method's multimethodological conceptual approach that incorporates theory building, experimentation, and observation into systems building. System building is a form of applied research that focuses on solving a specific problem. Further, the system development method theory uses observation, and experimentation (or prototyping) methodologies to create the system. The system development method has five basic steps:

- 1) Identify and/or generate theory applicable to solving an information system (IS) problem. The system development method does not need to create this theory, but one can instead use it to design and build a prototype system to test or implement the theory in solving the IS problem (see second to fifth steps).
- 2) Create the concept for the proposed system.
- 3) Design and develop the proposed system.
- 4) Apply and use the proposed system.
- 5) Evaluate the success of the proposed system in meeting one's research question or goals.

In this study, we accomplished the first two steps using the literature review. Thus, in the first step, we identified and used the literature related to indicators of human sex trafficking in ads to create an initial ontology. In the second step, we identified and applied the KM concept of using a set of strong filters based on the ontology in a KMS designed to assess a dataset of ads. In the third step, we created the prototype by actually generating the ontology/keywords and identifying processes for obtaining a data set, verifying the ontology/keywords against the dataset, and applying the ontology/keywords in order to analyze that dataset. In the fourth step, we applied the prototype that comprised the ontology/keywords and the processes that we created in the third step to assess a dataset for identifying victims of human sex trafficking. In step five, we evaluated the results from the fourth step and the proposed system to determine if the proposed system could accurately identify victims of human sex trafficking.

#### 3.2 Literature Review Method

We identified the appropriate literature using the following search terms in various combinations: "sex trafficking", "human trafficking", "United States", "America", "California", "online", "Internet", "social media", "backpage", "craigslist", "classifieds", and "technology". We began the literature review using Google Scholar to find papers that have received a high number of citations and to establish a baseline of pertinent literature. We conducted further searches using databases such as Ebscohost-Academic Search Premier, Scribd, and JSTOR. We used papers' references that particularly related to this study to find other similarly related papers. Finally, we searched the *Journal of Human Trafficking's* archives.

#### 3.3 Interview Method

As follow up to the literature review, we conducted unstructured interviews with law enforcement and individuals involved in efforts to combat online human sex trafficking and with academic researchers with expertise in the area of technology and human trafficking. Specifically, we interviewed a San Diego County's Sheriff's Department sergeant who was a member of their joint-agency human trafficking task force and two University of Southern California faculty members involved in Department of Justice and Humanity United-funded research projects focused on creating a better understanding of the role of technology in human trafficking activities and the use of data analytics to combat sex trafficking. We selected these interview subjects based on their availability, and a single interviewer conducted them in order to avoid bias. The interviews comprised two-open ended questions:

- Explain your main areas of research/methods for targeting and identifying online trafficking activities?



- How have you applied your knowledge of the language that traffickers use (ontologies) to efforts to combat or identify online sex trafficking activities?

Based on their responses, we asked the respondents to expand on certain areas that we deemed required a more detailed explanation. We intended these interviews to confirm the practical application of theory identified through the literature review and identify any additional knowledge areas the theory did not address. We identified several highlights. First, the human trafficking task force believes that an ad that features a sex worker as 25 years old or younger is most likely a minor. Second, the interviewees noted that one needs to consider the social implications in using technology to identify online human trafficking. Finally, they discussed the difficulty in distinguishing between trafficking and non-trafficking ads and the best approach to address this issue.

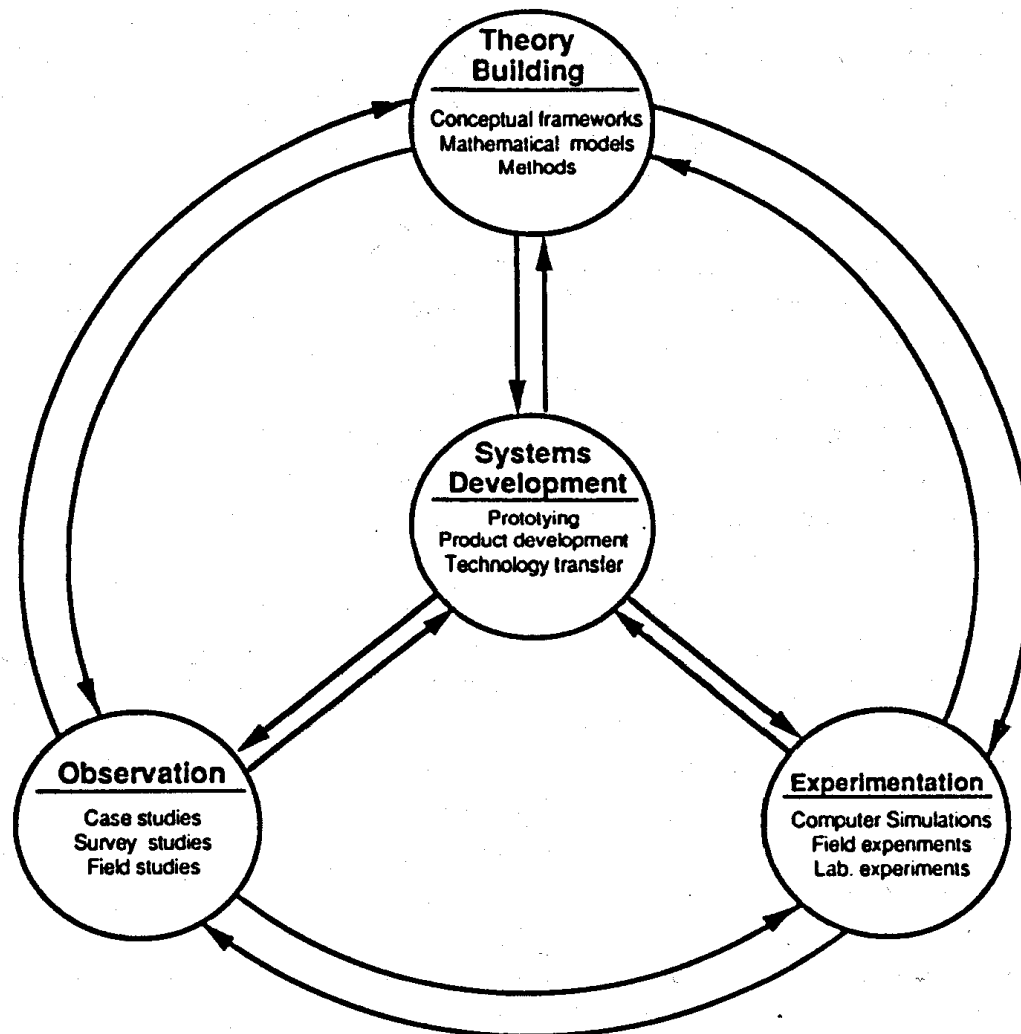


Figure 3. A Multimethodological Approach to IS Research (Nunnamaker et al., 1990, p. 94)

## 4 System Prototype Development

KM focuses on producing actionable intelligence. In this research, the actionable intelligence is the identification of ads that identify victims of human sex trafficking. To obtain this actionable intelligence, we created a KM strategy that used the system development methodology. This strategy required a system that applied strong filters to a large unstructured data set of “women seeking men” ads to eliminate those from genuine individuals. We identified the “women looking for men” section of backpage.com from various southern California cities as our data source. The initial system prototype used an initial ontology of keywords generated from the human trafficking literature as strong filters to demonstrate that it could identify potential trafficking victims. We refined the prototype by using expertise to refine the ontology and

by applying text mining/machine learning to verify the ontology of keywords and remove words that all or most ads included. We reapplied the refined ontology as strong filters against a second unstructured data set to demonstrate again that the system could identify trafficking victims from ads. Also as part of the strategy, we developed processes to extract an unstructured data set and for applying the strong filters to the unstructured data set to produce the desired actionable intelligence. In Sections 4.1 to 4.3, we describe how we created these strategy/prototype components.

## 4.1 Creating the Ontology/Keyword Set

To create an ontology/keyword set that could act as strong filters, we used a two-stage process with two different data sets. First, we used the keywords we identified (see Section 2.2) to identify which words from that list were in the first dataset. We extracted the keywords from each ad. To extract ethnic/nationality data, we used keywords in the filter feature of Microsoft Excel from both the text and title columns. We joined the Excel file to an area code location table to determine the origin of the phone number. We individually searched for area codes that the table did not represent online using Google. We used area code information to determine possible movement of providers. In all, 84 percent of the ads produced phone numbers, and we manually extracted another 12.6 percent because the ads disguised the phone numbers in some way. Ads often put random characters between numbers, write out the word, or use letters rather than numbers. Finally, 3.5 percent listed no phone number. We used the resulting list as the ontology/keyword set:

- Movement between cities included:
  - Transient language: new in town, just arrived, visiting, in town for the weekend two nights only, new arrival, new arrived, brand new, limited time
  - Group work: staff, ask for, my friend, sister, we, our, assistant
  - Phone number, actual numbers from the dataset (used for three indicators: duplicate phone number, disguised phone number, out of state area code)
- Restrained movement: incalls only, incall only, only incall, no outcall, contains incall but does not contain outcall
- Minor indicators: little girl, youthful, sweet, young, college student girl, new in town, fresh, turned 18, only 18, fantasy
- Unconventional sex: open minded, fetish, kinky
- Ethnicity: White, Black, Asian, Islander, Caucasian, African American, Latina, Hispanic, mixed

After reflecting on the first ontology, we realized that the ontology would not be permanent and continue to evolve, especially when the traffickers realized what their words could identify trafficking victims (see Section 5.2.3). Thus, we decided to obtain a second data set to verify the first stage ontology keyword set and to prototype applying the strong filters using R-based script. We verified the ontology keyword set from the first stage by applying experience from policing and research of human sex trafficking through unstructured interviews with human trafficking experts. Additionally, we used the text-mining module in R to parse the unstructured data to remove stop words and words that all or most ads included. The key issue was discriminating between keywords used in generic solicitations versus those used in marketing victims of human sex trafficking. The impact of these actions resulted in the 9 indicators in the initial ontology being reduced to 6 indicators for the revised ontology. The final ontology is:

- Sale of services: donation(s), price, rose(s), dollar(s), jacks, jacksons, hundreds
- Minor victims: fresh, young, new, tiny, little, new in town, girl, college
- Ethnicity:
  - African American: AA, African American, Brown Sugar, Black (Beauty)
  - Asian/Pacific Islander: Pocahontas, Asian, Pacific Islander
  - Caucasian: Caucasian, White, European
  - Latina: Latina, Hispanic
- Country of origin/nationality: South/East Asia, Eastern/Western Europe, Central America

- Transient activity/movement of victims: new in town, just arrived, weekend only, limited time, new arrival, brand new, in town for the weekend, gone, back, leaving soon, only for the weekend, new
- Non-independent worker/restricted movement: incall only, no outcall, only incalls, come to me, my house

## 4.2 Process for Extracting the Unstructured Dataset

We created the first unstructured dataset by scraping Web advertisements from websites known to post sexually explicit solicitations/ads. To make it usable for analysis, we converted the scraped data into a .csv file then manually processed into a Microsoft Excel file for analysis.

After reflection, we obtained the first data set mostly through a manual process, which we considered unsustainable for an automated system approach, so we decided to create a second data set to test the revised ontology. As such, we created an automatic Web-scraping tool with various approaches. However, this method did not work well because the target websites blocked automatic Web scraping. As a result, we scrapped the automated Web scraping and repeated the manual process to obtain a .csv file with the raw data. We then processed the raw data file using Excel to remove duplicate postings (in this study, we analyzed content and not frequency, so multiple postings would bias the results) and to identify records with missing data. We loaded the resulting processed raw data file into R's machine-learning and text-mining functions to remove stop words contained in the English stop word dictionary and to identify words common to all ads.

## 4.3 Process for Applying the Prototype

We developed a simple process that involved actual keyword counts to apply the ontology/keyword set to the unstructured dataset. We used count functions in Microsoft Excel to generate the number of times keywords appeared and to determine if an ad contained a trafficking indicator. We also used other mathematical functions in Microsoft Excel to generate results such as the percentage of ads that contained the keyword.

After reflection, we modified this process for the second prototype. Instead of using Excel to do word counts, we used R to code each add with a series of 0 or 1 codes. R coded each human trafficking victim indicator 0 if an ad contained no ontology/key word indicators or 1 if an ad did contain ontology/keyword indicators. R then summed the number of victim ontology/keyword indicators for each add. By using R to code the dataset, we could automate the analysis portion of the prototype.

# 5 Applying the Prototype

## 5.1 Creating the Dataset

The first application of the prototype used a dataset that we extracted from backpage.com for several cities in California. We chose California because we live in the state and because it is a major hub for prostitution and sex trafficking. California encompasses many ports of entry and lies adjacent to the Mexican border region, which is rife with human trafficking (Goldenberg, Silverman, Engstrom, Bojorquez-Chapela, & Strathdee, 2014).

We gathered data for the study by scraping from the "female escort" section of backpage.com from 11 to 16 February, 2015, across 15 different California cities/counties: Bakersfield, Chico, Fresno, Los Angeles, Merced, Oakland, Orange County, Sacramento, San Diego, San Francisco, San Jose, San Luis Obispo, Santa Barbara, Santa Cruz, and Stockton. Some errors occurred in the data-scraping process. San Diego only produced about two-and-a-half days of data due to an error, so the data sample for that city was smaller than that for the other large cities. In total, we scraped a total of 5,633 ads. We then processed the data as we discuss in Section 4.2.

After reflecting on the first data set, we collected the second data set from the "women seeking men" section of the dating classifieds on backpage.com. The sample included advertisements posted between February and March, 2017, for three major cities/counties in Southern California: San Diego, Los Angeles, and Orange County. We selected this sample because of the close proximity of the three cities, which makes the language used in the advertisements subject to less variability due to regional language

differences. The initial dataset comprised 8,940 records that we processed in accordance with Section 4.2; as a result, 8,744 records remained in the final data set.

## 5.2 Analyzing the Dataset

### 5.2.1 Analyzing the First Data Set Using the Initial Prototype

We analyzed the first data set as we discuss in Section 4.3. Specifically, we compiled keywords that indicate possible minor sex trafficking and analyzed them against the advertised age. We combined all ages past 30 into one group as the large majority of ages were between 20 and 25. Note that the advertised ages are not necessarily accurate, especially in trafficking situations. Traffickers may be more likely to advertise a victim of minor sex trafficking as being aged from 20 to 25—young enough to still attract the correct buyer but old enough not to raise law enforcement suspicion. Overall, we found a number of prominent age terms such as “sweet”, “young”, and “fantasy”; rarer terms included “only 18”, “turned 18”, “very young”, and “little girl”. Traffickers would not likely use the rarely used keywords for fear of attracting law enforcement. Additionally, terms such as “college student/girl”, “new in town”, and “fresh”, seem to skew slightly toward younger ages, which could indicate younger individuals.

Many ads had multiple keywords. Out of the sample of 5,633 ads, 4,836 had a least one indicator of human sex trafficking. By far the most prominent indicator was “duplicate phone/ad”. These results are similar to those that Latonero et al. (2012) found. Specifically, these authors found that a small number of phone numbers accounted for a disproportionate amount of ads; however, on reflection, we believe that this disproportion reflects people’s practice of keeping their mobile number even after moving and provides little information with respect to victims of human sex trafficking. As such, we can conclude that a single indicator of human sex trafficking cannot sufficiently identify a potential victim and that duplicate phone/ad by itself does not provide enough discerning information to identify a victim of human sex trafficking but that it is likely to be a good indicator in combination with other indicators.

The following list includes the percentage of total ads with the specified indicator present:

- Duplicate ad/phone number (54.8%)
- Ethnicity/national origin (44.9%)
- Unconventional sex (13.4%)
- Disguised phone number (12.5%)
- Out of state area code (12.1%)
- Restriction on movement (11.8%)
- Transient language (9.0%)
- Indications of working in a group (8.8%)
- Minor keyword indicators (5.2%)

The following list shows how many ads had multiple indicators (out of nine indicators):

- 4,836 had at least one indicator
- 3,126 had at least two indicators
- 1,354 had at least three indicators
- 330 had at least four indicators
- 74 had at least five indicators
- Eight had at least six indicators
- One had seven indicators.

### 5.2.2 Analyzing the Second Data Set Using the Revised Prototype

We analyzed the second data set as we discuss in Section 4.3.

The following list shows percentage of ads with the indicated indicator:

- Sales of service (1.56%)
- Minor (48.2%)

- Ethnicity (30.3%)
- Country of origin (11.4%)
- Transient language (12.67%)
- Restriction of movement (0.71%)

The following list shows how many ads had multiple indicators (out of 6 indicators):

- 3,534 ads had at least one indicator
- 1,768 ads had at least two indicators
- 467 ads had at least three indicators
- 33 ads had at least four indicators
- Two ads had five indicators

### 5.2.3 Discussion

We can see that one can use keywords to develop indicators of sex trafficking. Interestingly, in analyzing both data sets, we found that the number of ads with multiple indicators dropped quickly the more indicators that we identified. We expected this result, and it illustrates that the process works. Comparing the number of ads with multiple indicators to the 792 reported cases of human sex trafficking in California in 2015 (NHTRC, 2016) and 544 human sex trafficking cases in the first half of 2017 (Polaris Project, 2017) suggests that one can establish a threshold number of indicators that indicates a possible sex trafficking victim. The first data set suggests either four or five indicators as the threshold (out of nine indicators). Four is a conservative threshold that will not likely miss any victims but will probably include many false positives on potential victims because, in the sample, 330 ads had four indicators (about 40% of the yearly number of reported sex trafficking cases). Using five or more indicators strongly suggests a victim of sex trafficking: in our sample, five or more indicators yielded 74 potential victims (or 9.3% of the yearly number of reported sex trafficking cases). Given the limited resources available to law enforcement, a more focused number, although it may miss some potential victims, may be better. This logic suggests that one should use four indicators (out of six) in the second data set as the threshold because 33 ads is about six percent of the 544 cases reported in the first half of 2017. Thus, to sum up, we recommend that one should use five indicators (when one uses nine indicators total) or four (if one uses six indicators in total) as a threshold for recommending law enforcement intervention.

We also observed that, while phone-based indicators seemed to be useful in the first data set, we removed them from the revised ontology for the second data set. We removed duplicated phone numbers as an indicator because this indicator did not discriminate between trafficking phone use and regular prostitution phone use well enough. We dropped the other phone indicators (i.e., blocked or disguised phone numbers or out of area phone numbers) because it is becoming too common of a practice to usefully serve as an indicator (i.e., many people now commonly block or disguise their phone number for privacy and security reasons, and carriers now commonly allow customers to keep their phone numbers when they relocate). Conversely, we have a concern that the indicators do not do a good enough job discriminating between voluntary prostitution and sex trafficking victims. Ethnicity and to a lesser degree country of origin and minor indicators (especially in the second data set) do not discriminate between sex trafficking victims and voluntary prostitution and only work in conjunction with other indicators, which strengthens the argument for using at least four (when using six in total) or five (when using nine in total) indicators for initiating follow-up actions.

We used backpage.com for this research as a case study, but it only accounts for a portion of all online escort ads. We created a prototype that can be implemented into various websites. The difficulty in using it rests in the data-extraction process as we observed when we attempted to use craigslist.com. It may be possible to use the data-extraction process only when generating/validating the ontology and using the analysis process as a constant online monitoring and alarm tool.

## 6 Evaluating the Prototype

We evaluated the prototype by reflecting on the outcomes we generated when applying the prototype to a real data set. As a result, we created a revised data set that we tested. Again, we reflected on the results and generated further recommendations (see Section 7.4). Additionally, the system development

methodology includes a five-step evaluation process (Burstein & Gregor, 1999) for assessing the quality of the system development methodology process. We describe the results our evaluating these processes in this section. Overall, we note that the proposed prototype is acceptable as an output of the system development methodology because it met all steps of the five-step evaluation process.

## 6.1 Significance

Outcomes/artifacts from the system development research methodology should yield significant theoretical contributions, a system that yields better results than those systems currently in use, or both. In our case, we created the latter—a significant practical contribution that yields better results than the ones that currently exist.

Currently, law enforcement agencies search adult service classified ads to find pictures of people that look as though they are being trafficked (Latonero et al., 2012). Commonly, law enforcement agencies begin investigating possible sex trafficking by browsing through ads and looking for girls with pictures that look very young. If the girl looks underage, they may open an investigation (Latonero, 2011). They also compare an advertisement's picture with the advertised age. If they perceive a discrepancy between a girl's picture and her advertised age, law enforcement agencies may also open an investigation. Although these techniques have been one way to locate potential victims, they suffer from complications. First, it is extremely tedious and, second, photos are not always accurate (Latonero, 2011). While many law enforcement agencies use these tactics with some success, the system we propose in this paper may identify more potential victims without generating large numbers of false positives. We evaluate that the proposed ontology/system has practical significance.

## 6.2 Internal Validity

Internal validity refers to the credibility of one's results and whether they make sense. To develop our system, we used established theory to generate an ontology that we applied to an unstructured data set with the results that we present in this paper. The presented results are consistent and expected given the theory used and its application to the problem.

Further, to verify internal validity, we considered rival methods. We found other work that has investigated this research area, but it has all used some form of ontology-based method for identifying potential victims. For instance, Ibanez and Suthers (2014) used escort advertisement data to evaluate the significance of known indicators of online trafficking activity. They found that ads that contain two or more indicators are more likely to be instances of trafficking and that the most prevalent indicators for trafficking in order are ethnicity/nationality, potential restricted movement, movement along trafficking circuit, and shared management (multiple providers). Dubrawski, Miller, Barnes, Boecking, and Kennedy (2015) trained multiple random forest models using three different information-extraction approaches, term-frequency analysis using law enforcement provided keywords, regular expressions, and machine learning to weight 115 keywords. Alvari, Shakaria, and Snyder (2016) used a sample advertisements posted on backpage.com in March, 2016, to train a learning classifier. They used a semi-supervised learning algorithm to label the remaining advertisements and had experts in online sex trafficking review the classifications to evaluate accuracy. From considering Alvari et al. (2016), we added natural language processes and text mining in the prototype we used for the second data set.

## 6.3 External Validity

External validity concerns “the generalizability of a causal relationship to and across populations or persons, settings, and times” (Burstein & Gregor, 1999, p. 134). To test external validity, we applied the developed prototype across a variety of nationalities and ethnicities but all in the state of California. We note that one can apply the prototype to any population/ad sample in the United States, but it may not be generalizable directly to other cultures. We do believe the indicators are applicable for other cultures and countries, but one would need to adjust the ontology to fit their language(s)/culture(s). Using the AI and machine learning approaches incorporated into the second prototype provides a means for identifying and adjusting indicator terms based on language and culture differences. Thus, we note that the revised prototype has external validity for the United States and has external validity for other cultures/countries when one adjusts the prototype processes for culture/country.

## 6.4 Objectivity/Confirmability

Objectivity/confirmability concerns ensuring research does not suffer from researcher bias or that the researcher at least reports and discusses them. By basing the indicators on the literature and then generating the ontology by using the words in the extracted data, we removed much of our own bias for our prototype. Further, we used machine learning and text mining in the revised prototype to further reduce it.

## 6.5 Reliability/Dependability/Auditability

Reliability/dependability/auditability concerns quality control. We developed our system using a process that is consistent and stable across researchers and methods. We relied on the literature and the accepted system development research methodology to generate the prototype. Thus, we can conclude our prototype has sufficient reliability, dependability, and auditability.

## 7 Conclusions

We conclude that our prototype works and that it deserves further development. We found that the prototype meets the requirements of the system development methodology from action research and that it yields promising results when tested against actual data sets. We also recommend that one develop an alert/warning system based on this research that can provide a warning when ads contain five or more indicators (when using the nine ontology) or four or more indicators (when using the six ontology)—figures we determined based on comparing the number of ads the indicators identified with the number of reported victims (i.e., 792 for the first data set (NHTRC, 2016) and 544 for the second data set (Polaris Project, 2017)). We expect the suggest alarm system to result in a low number of positive alarms.

Further, we conclude that the system development method, especially when used with KM, is a viable approach to conducting research into developing systems to solve social problems. We found the method very useful for taking the emphasis off the application of new technologies and keeping the research focused on solving a social problem and building a system to do so.

### 7.1 Implications for Research

The initial prototype is a proof of concept, while the revised prototype moves towards an automated system; however, neither creates any new theory. Research focused on integrating more advanced technologies into a KM system for generating actionable intelligence that authorities can act on could generate significant social benefit. Specifically, we need future research that further focuses on automating the prototype's data-extraction process. A framework for developing the full automated system should be developed based on this research and the framework presented in Jennex (2017a, 2017b), a proposed KM model based on a modified knowledge pyramid and the revised Jennex-Olfman KM Success Model.

### 7.2 Implications for Practice

Finding victims of human sex trafficking is difficult and requires all the technology innovation possible. The practice of using posted photos and facial recognition is not working well and needs improvement. In this study, we suggest how one can use technology in practice to identify victims of sex trafficking. Practitioners will need to adapt to the processes that we illustrate in the paper and to adapt their intelligence gathering and investigative techniques to take advantage of the technology we prototyped.

### 7.3 Limitations

Our study has two major limitations. First, we looked only at female victims. While we recognize that males can also be victims of human sex trafficking, we did not include males in the study because we sought only to demonstrate whether one could use a KMS to identify victims. Thus, we limited the study to females to make it easier to design and demonstrate the KMS.

Second, we cannot prove conclusively that the potentially identified victims were in fact real victims. Given ethical concerns with the research, we could not actively interview rescued victims or actively search for victims.

Both limitations may impact the generalizability of the proposed system but are considered acceptable for this type of research.

## 7.4 Areas of Future Research

Researchers could extend our findings by investigating at least two areas. First, researchers could examine male victims to determine if the indicators and keywords differ from female victims. Second, they could investigate technologies that can be used to create an automated KMS. We used Excel to conveniently demonstrate a proof of concept in the initial prototype. The second prototype incorporated text mining and machine learning to assist in automatically generate an ontology and analyze data. Thus, our approach experienced weaknesses in extracting data, and future research needs to develop and automate the data-extraction process.

Additionally, data from online adult service ads can be used to inform the study of the commercial sex industry and, consequently, sex trafficking. The data we gathered shows indications of the geographic trafficking patterns across state borders and the demographic makeup of many individuals. This information can help identify previously unknown trends in sex trafficking.

Finally, we noticed an increase use of emojis in the ads' language. Further research needs to determine what these emojis mean and if one can also use them to detect sex trafficking victims.

## 8 Acknowledgements

We presented an earlier version of this paper at the 49th Hawaii International Conference on Systems Sciences, HICSS, in January, 2016.



## References

- Alavi, M., & Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 25(1), 107-136.
- Aldea, A., Banares-Alcantara, R., Bocio, J., Gramajo, J., Isern, D., Kokossis, A., Jiménez, L., Moreno, A., & Riano, D. (2003). An ontology-based knowledge management platform. In *Proceedings of the Workshop on Information Integration on the Web* (pp. 7-12).
- Almeida, M. B., & Barbosa, R. R. (2009). Ontologies in knowledge management support: A case study. *Journal of the American Society for Information Science and Technology*, 60(10), 2032-2047.
- Alvari, H., Shakarian, P., & Snyder, J. E. K. (2016). A non-parametric learning approach to identify online human trafficking. In *Proceedings of the IEEE International Conference on Intelligence and Security Informatics: Cybersecurity and Big Data* (pp. 133-138).
- Banks, D., & Kyckelhahn, T. (2011). Characteristics of suspected human trafficking incidents, 2008-2010. *U.S. Department of Justice*. Retrieved from <http://bjs.ojp.usdoj.gov/content/pub/pdf/cshti0810.pdf>
- Bouche, V., (2015). A report on the use of technology to recruit, groom and sell domestic minor sex trafficking victims. *Thorn Foundation*. Retrieved from [https://www.wearethorn.org/wp-content/uploads/2015/02/Survivor\\_Survey\\_r5.pdf](https://www.wearethorn.org/wp-content/uploads/2015/02/Survivor_Survey_r5.pdf)
- Boyd, D., Casteel, H., Thakor, M., & Johnson, R. S., (2011). Human trafficking and technology: A framework for understanding the role of technology in the commercial exploitation of children in the US. *Microsoft Research*.
- Burstein, F. V., & Gregor, S. (1999). The systems development or engineering approach to research in information systems: An action research perspective. In *Proceedings of 10th Australasian Conference on Information Systems* (pp. 122-134).
- Churchman, C. W. (1979). *The systems approach (revised and updated)*. New York: Dell Publishing.
- Dank, M., Khan, B., Downey, P. M., Kotonias, C., Mayer, D., Owens, C., & Yu, L. (2014). Estimating the size and structure of the underground commercial sex economy in eight major US cities. *The Urban Institute*. Retrieved from <https://www.urban.org/sites/default/files/alfresco/publication-pdfs/413047-Estimating-the-Size-and-Structure-of-the-Underground-Commercial-Sex-Economy-in-Eight-Major-US-Cities.PDF>
- Davenport, T. H., & Prusak, L. (1998). *Working knowledge*. Boston, MA: Harvard Business School Press.
- Department of Homeland Security. (2014). *What is human trafficking?* Retrieved from <http://www.dhs.gov/definition-human-trafficking>
- Dubraski, A., Miller, K., Barnes, M., Boecking, B., & Kennedy, E. (2015). Leveraging publicly available data to discern patterns of human-trafficking activity. *Journal of Human Trafficking*, 1, 65-85.
- Equality Now. (2017). *Global sex trafficking fact sheet*. Retrieved from <https://www.equalitynow.org/sites/default/files/Equality%20Now%20Sex%20Trafficking%20Fact%20Sheet.pdf>
- Goldenberg, S. M., Silverman, J. G., Engstrom, D., Bojorquez-Chapela, I., & Strathdee, S. A. (2014). "Right here is the gateway": Mobility, sex work entry and HIV risk along the Mexico-US border. *International Migration*, 52, 26-40.
- Gruber, T. R. (1995). Toward principles for the design of ontologies used for knowledge sharing. *International Journal of Human and Computer Studies*, 43(5/6), 907-928.
- Harris, K. D. (2012). *The state of human trafficking in California*. California Department of Justice. Retrieved from <https://oag.ca.gov/sites/all/files/agweb/pdfs/ht/human-trafficking-2012.pdf>
- Holsapple, C. W., & Joshi, K. (2004). A formal knowledge management ontology: Conduct, activities, resources, and influences. *Journal of the American Society for Information Science and Technology*, 55(7), 593-612.

- Ibanez, M., & Suthers, D. D. (2014). Detection of domestic human trafficking indicators and movement trends using content available on open Internet sources. *In Proceedings of the Hawaii International Conference on System Sciences* (pp. 1556-1565).
- Jennex, M. E. (2005). What is knowledge management? *International Journal of Knowledge Management*, 1(4), i-iv.
- Jennex, M. E., & Bartczak, S. E. (2013). A revised knowledge pyramid. *International Journal of Knowledge Management*, 9(3), 19-30.
- Jennex, M. (2017a). Re-examining the Jennex Olfman knowledge management success model. *In Proceedings of the Hawaii International Conference on System Sciences*.
- Jennex, M. E. (2017b). Big data, the Internet of things and the revised knowledge pyramid. *Data Base for Advances in Information Systems*, 48(4), 69-79.
- Juniper Networks. (2014). *Human trafficking in Silicon Valley*. Retrieved from <https://flipflashpages.uniflip.com/3/88537/339160/pub/html5.html#page/1>
- Jurisica, I., Mylopoulos, J., & Yu, E. (1999). Using ontologies for knowledge management: An information systems perspective. *In Proceedings of the Annual Meeting-American Society for Information Science* (vol. 36, pp. 482-496).
- Latonero, M. (2011). *Human trafficking online: The role of social networking sites and online classifieds*. University of Southern California. Retrieved from [https://technologyandtrafficking.usc.edu/files/2011/09/HumanTrafficking\\_FINAL.pdf](https://technologyandtrafficking.usc.edu/files/2011/09/HumanTrafficking_FINAL.pdf)
- Latonero, M., Musto, J., Boyd, Z., Boyle, E., Bissel, A., Gibson, K., & Kim, J. (2012). *The rise of mobile and the diffusion of technology-facilitated trafficking*. University of Southern California, Center on Communication Leadership & Policy.
- Major, M. (2012). *Technology and human trafficking*. University of Idaho. Retrieved from [http://www2.cs.uidaho.edu/~oman/CS336/Major\\_HumanTrafficking.pdf](http://www2.cs.uidaho.edu/~oman/CS336/Major_HumanTrafficking.pdf)
- National Human Trafficking Resource Center (NHTRC). (2015). *NHTRC 2014 California state report*. Retrieved from [http://traffickingresourcecenter.org/sites/default/files/NHTRC%202014%20California%20State%20Report%20-%20CA%20-%202001.01.14%20-%202012.31.14\\_0.pdf](http://traffickingresourcecenter.org/sites/default/files/NHTRC%202014%20California%20State%20Report%20-%20CA%20-%202001.01.14%20-%202012.31.14_0.pdf)
- National Human Trafficking Resource Center (NHTRC). (2016). *NHTRC hotline statistics*. Retrieved from <https://traffickingresourcecenter.org/states>
- National Institute of Justice. (2012). *Human trafficking*. Retrieved from <http://www.nij.gov/topics/crime/human-trafficking/pages/welcome.aspx>
- Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company—how Japanese companies create the dynamics of innovation*. Oxford, UK: Oxford University Press.
- Nunamaker, J., Chen, M., & Purdin, T. (1990). Systems development in information systems research. *Journal of Management Information Systems*, 7(3), 89-106.
- Operation Broken Silence (OBS). (2012). *The Nashville backpage report: An analysis of the online commercial sex industry and human trafficking in Tennessee*. Retrieved from <http://www.operationbrokensilence.org/wp-content/uploads/2012/01/Nashville-BackpageReport.pdf>
- Polanyi, M. (1967). *The tacit dimension*. London: Routledge.
- Polaris Project. (2017). *California statistics*. Retrieved from <https://humantraffickinghotline.org/state/california>
- Raymond, J. G., Hughes, D. M., & Gomez, C. J. (2001). *Sex trafficking of women in the United States. Coalition Against Trafficking in Women*. Retrieved from [http://bibliobase.sermais.pt:8008/BiblioNET/upload/PDF3/01913\\_sex\\_traff\\_us.pdf](http://bibliobase.sermais.pt:8008/BiblioNET/upload/PDF3/01913_sex_traff_us.pdf)
- Varma, V. (2007). Use of ontologies for organizational knowledge management and knowledge management systems. In R. Sharman, R. Kishore, & R. Ramesh (Eds.), *Ontologies* (ISIS vol. 14, pp. 21-27). Berlin: Springer.

- Wu, J., & Yang, G. (2005). An ontology-based method for project and domain expert matching. In L. Wang, & Y. Jin (Eds.), *Fuzzy systems and knowledge discovery* (LNCS vol. 3614, pp. 176-185). Berlin: Springer.
- Yen, I., (2008). Of vice and men: A new approach to eradicating sex trafficking by reducing male demand through educational programs and abolitionist legislation. *Journal of Criminal Law and Criminology*, 98(2), 653-686.

## About the Authors

**Marisa Hultgren** holds a Master of Science in Homeland Security from San Diego State University and a Bachelor of Arts in History and Geography with a concentration in Geographic Information Systems from California State University, Stanislaus. She previously worked as a defense contractor in San Diego and has volunteered in support of human trafficking survivors in the United States. She has also volunteered abroad in both Laos and Mongolia teaching disadvantaged teachers English. The main context of her research has been that of counter sex trafficking with an emphasis on the detection of victims through text mining of online data.

**Jessica Whitney** is a Masters' student and Graduate Assistant in the Management Information Systems department of San Diego State University's Fowler College of Business. She also holds a BS in Marketing with a specialization in Integrated Marketing Communications. Her research is focused on the use of technology and knowledge management principles for the identification of online human trafficking and decision support for the effective response to technology-driven insight in this field. She currently works in the Information Technology Division of the San Diego County District Attorney's office supporting the technology used by attorneys, support staff, and investigators in their pursuit to protect the innocent and prosecute the criminals.

**Murray E. Jennex** is a Professor of Management Information Systems in the Fowler College of Business at San Diego State University, Editor in Chief of the *International Journal of Knowledge Management*, co-editor in chief of the *International Journal of Information Systems for Crisis Response and Management*, and president of the Foundation for Knowledge Management (LLC). He specializes in knowledge management, crisis response, system analysis and design, IS security, e-commerce, and organizational effectiveness. He serves as the Knowledge, Innovation, and Entrepreneurial Systems Track co-chair at the Hawaii International Conference on System Sciences. He is the author of over 150 journal papers, book chapters, and conference proceedings on knowledge management, crisis response, end user computing, international information systems, organizational memory systems, ecommerce, cyber security, and software outsourcing. He is a former US Navy Nuclear Power Propulsion officer and holds a BA in chemistry and physics from William Jewell College, an MBA and an MS in software engineering from National University, an MS in telecommunications management and a PhD in information systems from the Claremont Graduate University. He is also a registered professional mechanical engineer in the state of California and a Certified Information Systems Security Professional (CISSP), a Certified Secure Software Lifecycle Professional (CSSLP), and a Project Management Professional (PMP).

**Aaron C. Elkins** is an Assistant Professor in the department of Management Information Systems and Director of the SDSU Artificial Intelligence Lab. His research focuses on developing AI models that fuse physiological and behavioral sensor data to predict human emotion and deception. Elkins conducts experiments investigating automated deception detection in the laboratory, borders, and airports. Complementary to the development of advanced AI systems is their impact on the people using them to make decisions. He also investigates how human decision makers are psychologically affected by, use, perceive, and incorporate the next generation technologies into their lives.

Copyright © 2018 by the Association for Information Systems. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and full citation on the first page. Copyright for components of this work owned by others than the Association for Information Systems must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists requires prior specific permission and/or fee. Request permission to publish from: AIS Administrative Office, P.O. Box 2712 Atlanta, GA, 30301-2712 Attn: Reprints or via e-mail from [publications@aisnet.org](mailto:publications@aisnet.org).